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THE NAUTILUS

THE PILSBRY QUARTERLY
DEVOTED TO THE INTERESTS
OF CONCHOLOGISTS

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VOL. 77
JULY, 1963 to APRIL, 1964

EDITORS AND PUBLISHERS

HORACE BURRINGTON BAKER
Professor Emeritus of Zoology, University of Pennsylvania

CHARLES B. WURTZ
Biology Department, La Salle College, Philadelphia 41, Pa.

R. TUCKER ABBOTT
H. A. Pilsbry Chair of Malacology, Academy of Natural Sciences

MRS. HORACE B. BAKER

PHILADELPHIA, PENNSYLVANIA

PONY PRINTING, UPPER DARBY, PA.

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THE NAUTILUS

Vol. 77 July, 1963 No. 1

GENUS OLIVELLA IN EASTERN PACIFIC

By JOHN Q. AND ROSE L. BURCH

The preparation of a key to species based upon shell characters is always a problem when working with any group. A dichotomous key giving the choice of two alternatives is in favor by many authors, but there are times when this is difficult. In some families, a key may be made simply on obvious morphological characters such as "shell with bands on the body whorl," and let taxonomy go where it may. However, in the Olividae, the worker will immediately be confronted with specimens that are certainly of the same species with some having one band, others 2 or 3 bands, and others with no bands. In the genus *Olivella,* in our opinion, the most dependable character is the pillar structure, and we have arranged the genus largely on this basis. Our opinion is that the multitude of names given to species of this family is because authors have failed to consider variation caused by races. The tendency of a single species to appear in numerous color forms is also a contributing factor.

In giving credit to those who have helped us, please do not assume that they agree with all our conclusions. We wish to acknowledge our indebtedness to Axel A. Olsson whose publication in 1956 of "Studies in the genus *Olivella*" is the most scholarly work on this genus to come to our hands. He has sent type specimens of his species from the eastern Pacific to us for study. Dr. A. Myra Keen helped us with advice, specimens, and the privilege of studying the Stanford collection. Dr. Leo G. Hertlein and Dr. G. Dallas Hanna made available to us the large collection and library of the California Academy of Sciences as well as many useful suggestions. Mr. and Mrs. E. P. Chace gave us free use of the material in the collections of the Natural History Museum of San Diego where we studied the collections of Herbert Lowe, A. M. Strong, and others. They also discussed many problems with us. Dr. S. S. Berry permitted us to study and photograph type specimens in his collection, and also gave us many

valued comments. The Public Museum of Liverpool, England, sent type specimens of F. P. Marrat for us to study. Dr. R. Tucker Abbott of the Academy of Natural Sciences of Philadelphia sent the holotype of *Olivella bitleri* Olsson, and a paratype of *Olivella gracilis gaylordi* Ford. Dr. Harald Rehder of the United States National Museum sent the type of *Olivella morrisoni* Olsson for our study.

All measurements mentioned are either of the type specimen or are approximate. Plate 1 contains figs. 1 to 9; pl. 2, figs. 10 to 18; and plate 3, facing page 28, figs. 19 to 27.

The acceptance of *Olivella pedroana* (Conrad 1856), and placing *Olivella pycna* Berry, 1935 (fig. 16) in synonymy is a controversial matter. We are satisfied that they are the same species, but there are many who object to the use of a name based upon a fossil when there is any question involved. A study of the soft parts of *Olivella pedroana* is obviously impossible. Furthermore, Conrad's type was lost. Dr. W. P. Woodring selected a lectotype and placed it in the U. S. National Museum. The validity of this action is the source of another controversy. We have no quarrel with those who prefer to use the name *Olivella pycna* Berry, 1935.

Olivella intorta Carpenter, 1856, has been questionable for many years, but specimens from Magdalena Bay, Baja California, Mexico (fig. 14) seem to fill all details of Carpenter's description.

Olivella zonalis (Lamarck, 1811), (fig. 25), presents a problem if we are to use numerous subgenera. It will key out into the same group with those of the subgenus *Callianax,* but it possibly should have a subgeneric name to contain it.

The small turrite species, *Olivella inconspicua* (C. B. Adams 1852) (fig. 13), was not well known until Dr. Ruth Turner published her work on the C. B. Adams types. The species seems to be strictly confined to Panama, but many sets are in collections incorrectly assigned to this species. Most of them seem to be *Olivella alba* (Marrat in Sowerby), which is a very different shell.

Numerous varieties of *Olivella biplicata* (Sowerby, 1825), (fig. 4), have been given names. We dismiss the white *lapillus* along with *fucana, angelena, parva,* and others as mere forms with no systematic value.

Olivella baetica (Marrat in Sowerby, 1871), (fig. 3), has been generally given to P. P. Carpenter, 1864, but Dr. Katherine Palmer, 1958, has shown that we cannot use Carpenter, but must give it to Marrat, who first figured and described it. A number of races have been named ranging from Alaska to far down the outer coast of Baja California, Mexico. We consider these of no systematic value with the possible exception of *Olivella porteri* Dall, 1910. This is placed in the synonymy, but it may be a recognizable race. It is a slender, deeper water form of *Olivella baetica.*

Olivella alba (Marrat in Sowerby, 1871), (fig .1), was not well known as a species of this fauna prior to the work of A. Olsson, 1956. There are sets in almost all large collections incorrectly assigned to *Olivella inconspicua* (C. B. Adams 1852), *Olivella miriadina* (Duclos 1835), and others that are of this species.

Olivella tergina (Duclos, 1835), (fig. 21), is a common species around Mazatlan, scarcer in the Gulf of California. Surprisingly, it is often confused with *Oliva (Strephonella) undatella* (Lamarck, 1811). They have in common the strong lirae extending to near end of aperture, and are of somewhat similar shape and color, but the pillar of *Oliva undatella* is not secondarily excavated, and the posterior plicae are much stronger.

Typical specimens of *Olivella gracilis* (Broderip and Sowerby, 1829), (fig. 12), are more elongate with the whorls steeply descending. It is a large species of 20 mm. or more. However, there are many groups of shells with the identical pillar structure and even the color of *Olivella gracilis,* but varying greatly in both shape and size. We either have a great many more species or subspecies, or as we suspect, many races of one entity. *Olivella gracilis,* variety *gaylordi* Ford, 1894, (fig. 26), has the pillar structure of *Olivella gracilis,* but is much smaller with a well defined line of lead black bordering the upper part of the body whorl. The general color is bluish gray. Having studied the type lot we would consider this a good species or subspecies, but have failed to recognize it in any of the material we have seen.

We are satisfied that *Olivella walkeri* Berry, 1958, (fig. 23), is a distinct and recognizable species, but we are not pleased with the assignment of the author to subgenus *Macgintiella* Olsson, 1956. Olsson described this species based upon the type species

Olivella watermani McGinty mainly because of the peculiar radula, the rhachidian tooth of which is completely different from that shown in any other species. The radula was not shown in Olsson's work of 1956, and the above information is by personal communication, June 29, 1962. The pillar structure is that of *Olivella* s.s., and on shell characters alone we think that we are justified in placing *Olivella walkeri* Berry in the subgenus *Olivella*.

It has been our privilege to study the type lot of *Olivella versicolor* (Marrat in Sowerby, 1871), (fig. 27). We might accept this species, but have failed to recognize it in any of the material we have studied. The pillar structure is that of the *Olivella gracilis* group, and has been placed in the synonymy of that species by Dr. Myra Keen and others. Maxwell Smith in "Panamic Shells" figured it as a valid species ranging from Baja California to Ecuador. Weinkauff adds the note "Species dubiosa." We concur.

KEY TO EASTERN PACIFIC SUBGENERA AND SPECIES

1 Parietal callus not extending past apical end of aperture, or but little above it
  2 Columella basally with simple, or sometimes lirate, pillar fold. *Callianax* H. & A. Adams, 1853
    3 Columella ending in a simple plica
      4 Parietal callus not entending above aperture; shell ellipsoid with strong basal plica; 13 mm. (fig. 16) *pedroana* (Conrad, 1856)
      4 Parietal callus extending above aperture, but not to suture; shell ellipsoid; spire short, pointed; 14 mm. (fig. 14) *intorta* (Carpenter, 1856)
      4 Columella with one plait at base; body whorl yellowish or pinkish with 3 brownish red, spiral bands, with chestnut blotch at upper end of parietal wall; narrow brown band at base ending in basal notch; 4 to 5 mm. (fig. 25) *zonalis* (Lamarck, 1811)
    3 Columella ending in double plicae
      4 Shell broad and stout; spire conic; usually bluish gray, unicolor; 25 mm. (fig. 4) *biplicata* (Sowerby, 1825)
      4 Shell oblong; spire sharp-pointed; color grayish or drab, with darker spots; 15 to 20 mm. (fig. 3) *baetica* (Marrat in Sowerby, 1871)
  2 Columella basally with one plain fold, bordered externally by low groove; shell minute; spire turrite; small blunt nucleus; 3.5 mm. (fig. 13) *inconspicua* (C. B. Adams, 1852)

Minioliva Olsson, 1956

1 Parietal callus extending past aperture to or near suture
2 Pillar wall concave or deeply excavated; lirae of inner lip if present cut off sharply at inner ends.

3 Pillar and parietal wall covered fully by a thick callus; no pillar or parietal lirae at any stage *Pachyoliva* Olsson, 1956

4 Callus with short knob-like spire and large body whorl; spire and fasciole white; body whorl with 3 broad brown or bluish-gray, spiral bands; 14 mm. (fig. 8) *columellaris* (Sowerby, 1825)

4 Pillar and color pattern similar, but with higher, slenderer and sharply pointed spire, and less calloused; apical ½ of body whorl with faint series of vertical striae; 15 mm. (fig. 20) *semistriata* (Gray, 1839)

3 Pillar with lirae along parietal and columellar wall *Olivella* Swainson 1840

4 Pillar with 3 or 4 oblique lirae below and 3 shorter ones above; color white, often with much darker apex; conic spire half of length; 4 mm. (fig. 1) *alba* (Marrat in Sowerby, 1871)

4 Pillar with 4 or 5 strong, descending lirae on basal part of columella; shell light and thin, with high turrite spire; color dull white or cream, sometimes with faint spots or flammules of brown in 3 zones (below suture and around middle and base); shape similar to alba, but with thinner shell; 7 to 8 mm. (fig. 18) *rehderi* Olsson, 1956

4 Pillar with one large fold below, followed above by a few small plaits which do not extend above the middle; wide fasciolar band of yellow or white; color white, variably marked with brownish or grayish zigzags; apex of spire and aperture violet; 18 to 20 mm. (fig. 9) *dama* (Wood, 1828)

4 Pillar with 6 or 7 strong lirae extending along parietal wall to near angle; shell narrowly egg-shaped; spire nearly ½ length; color pattern gray or yellow blotches and arrow-shaped, white marks edged with brown; 16 mm. (fig. 21) *tergina* (Duclos, 1835)

4 Pillar similar to *tergina,* with 7 lirae, of which apical 3 arch around anterior canal; shell subellipsoid, spire less than ½ length; color pattern of brown, zigzag lines and 2 dark bands just below the suture; fasciolar band with brown checks; 8.5 mm. *altatae* Burch & Campbell, 1963

4 Pillar with series of small lirae extending along col-

umellar part towards parietal wall; color gray or purplish brown shadings, formed by dense pattern of small dots spread over surface in ill-defined bands; related to *tergina* but separable by more ellipsoid shape; 17.5 mm. (fig. 6) *brogii* Olsson, 1956

4 Pillar deeply excavated; 6 or 7 rather uniform and heavy folds on columella; shell slender fusiform; color whitish with irregular reticulations; 20 mm. (fig. 12) *gracilis* (Broderip & Sowerby, 1829)

4 Pillar and color as in *gracilis,* but smaller, with shorter spire and more heavily calloused whorls; 10 mm. (fig. 7) *cocosensis* Olsson, 1956

4 Pillar with several small lirae extending upward along about ½ of inner lip; shell thin, white or yellowish brown, translucent except for opaque white fasciole; spire elevated, evenly tapering; suture narrowly grooved with the junction showing through as a faint line; 10 mm. (fig. 10) *drangai* Olsson, 1956

4 Pillar with narrow raised plate bearing 5 or 6 entering folds; fasciole smooth and wide; color light yellowish brown on whitish or creamy ground; parietal callus thinning out before reaching the suture; 10 mm. (fig. 11) *fletcherae* Berry, 1958

4 Pillar similar to *fletcherae,* with 8 to 10 fairly equal plicae set apart from parietal callus; fasciolar band white with brown bars or squares; color gray with 2 bands below suture joined with narrow brown bars; parietal callus semitransparent; interior of outer lip dark brown; 10 mm. *steveni* Burch & Campbell, 1963

4 Pillar similar to *steveni;* 10 lirae on columella almost to apertural angle; upper folds wider and flat, becoming narrower anteriorly with 8th and 9th most prominent; shell obese, white with brown markings; subsutural spiral bands more intense; fasciolar band with brown blotches; interior of outer lip brown; 10 mm. *steveni campbelli* Burch & Campbell, 1963

4 Deep brown callus extending upward past end of aperture, but not quite to suture; upper part of fasciole brown but white below; interior of outer lip dark brown; color and form similar to *volutella,* but with pillar like *Olivella* s.s.; 15 mm. (fig. 5) *bitleri* Olsson, 1956

4 Pillar weak, forming a low ridge along columella, finely lirate below; shell thin, spindle shaped with elevated spire; gray-yellow base color mottled by small brown blotches, which form short crooked lines at su-

ture; interior of outer lip deep brown; 12.7 mm. (fig. 19) *riverae* Olsson, 1956

4 Pillar similar to *riverae,* with 12 lirae forming a narrow area along columella; wider upper folds becoming narrow and more vertical basally; inflated shell white covered by small brown spots, with 2 narrow brown bands below suture joined with vertical bars; fasciolar band spotted with brown and rest of fasciole with several brown arcs; 15 mm. *sphoni* Burch & Campbell, 1963

4 Sulcate fold bounding canal, with 2 plicae below and several above; parietal callus heavy, wide, sharply bounded, extending to whorl above; color spire and fasciole ivory yellow, rest whitish, indistinctly marked with pale brown, few minute spots under suture; aperture ⅔ shell. 10.5 mm. (fig 23) *walkeri* Berry, 1958

2 Parietal wall not excavated; lirae of inner lip continuing undiminished into interior. *Lamprodoma* Swainson, 1840

3 Lirae numerous, extending upward along pillar to edge of fasciole, absent from wall above; spindle shaped with high spire. 19 mm. (fig. 22) *volutella* (Lamarck, 1811)

3 Plicae fewer and shorter, confined to columellar part. *Zanoetella* Olsson, 1956

4 Pillar with 4 to 5 long plicae around anterior end; color white with 2 purplish-brown spiral bands. 17 mm. (fig. 24) *zanoeta* (Duclos, 1835)

3 Lirae on pillar wall forming a separate structure in form of tongue-shaped ridge; interior of outer lip with fine, low lirae. *Dactylidella* Woodring, 1928

4 Spire high and slender; color zigzag pattern of darker lines; fasciole solid brown. 18 mm. (fig. 2) *anazora* (Duclos, 1835)

3 Pillar forming tongue along inner lip, widest below where it extends outward assuming a hook-shaped form; rest evenly and finely crenulate; outer lip sharp. *Niteoliva* Olsson, 1956

4 Pillar finely lirate terminating in larger denticle at each end; narrowly subovate with high conic spire; color gray with brown zigzag lines on white or yellow base edged with gray or brown; parietal callus white; fasciole wide, double; upper band narrow, white or colored, lower band gray or brown. 13 mm. (fig. 17) *petersoni* Olsson, 1956

4 Pillar with about 7 small lirae between upper and lower denticles; outer lip smooth; color dull white with zigzag dark-brown marks; spire whorls white; fasciole

wide, dark brown in color except narrow white band above. 9 mm. (fig. 15) *morrisoni* Olsson, 1956

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SUPPLEMENTARY NOTES ON PRE-COLUMBIAN LITTORINA LITTOREA IN NOVA SCOTIA

By A. H. CLARKE, JR.
National Museum of Canada

Recently Erskine (1961) and Clarke and Erskine (1961) recorded the occurrence of *Littorina littorea* L. in two ancient Micmac Indian camp sites excavated near Halifax, Nova Scotia. The presence of distinctive Indian artifacts, reindeer bones, and thickened valves of *Mercenaria mercenaria* found associated with

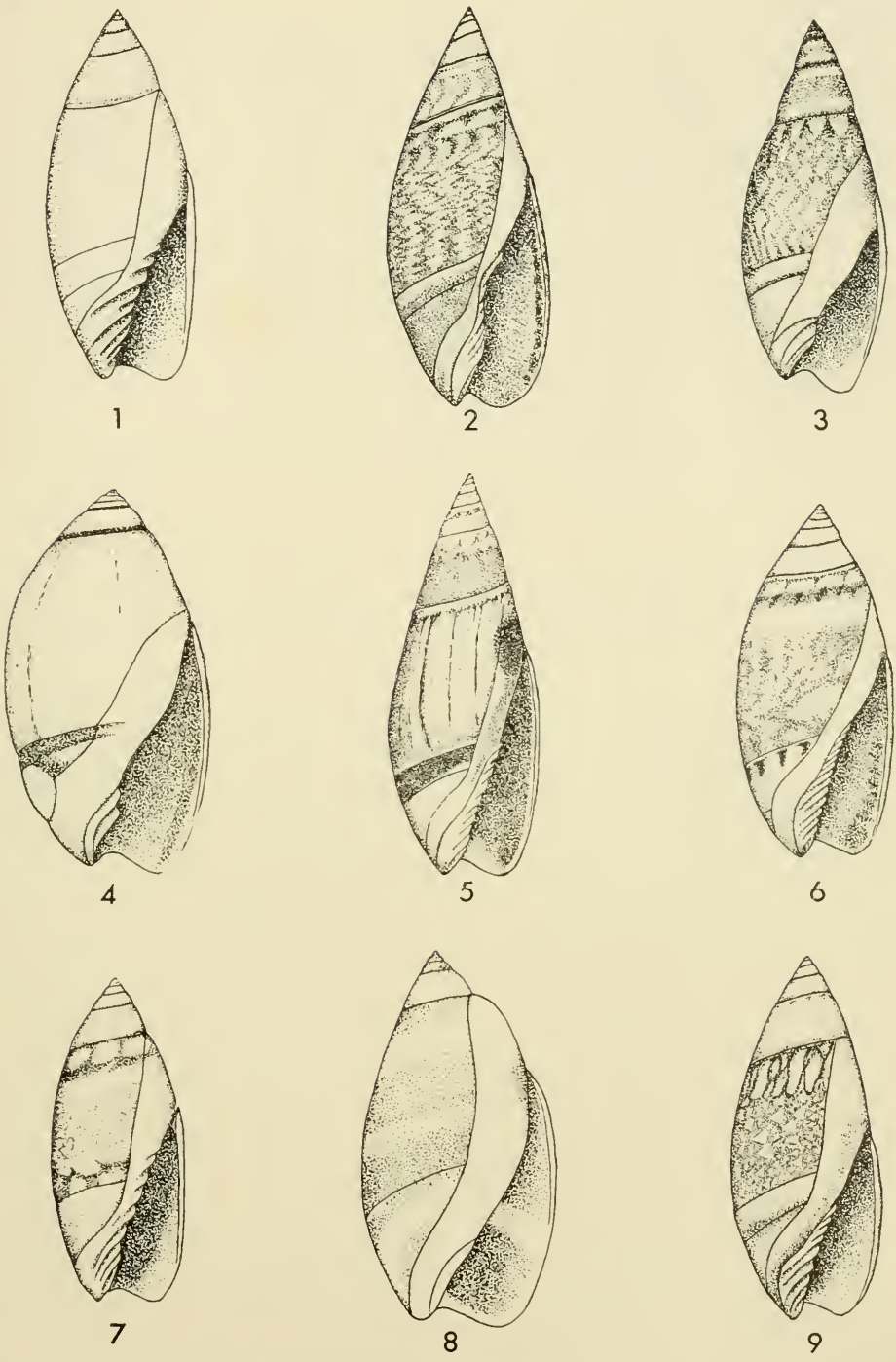

Fig. 1. *Olivella alba* (Marrat in Sowerby, 1871). Guatemala. 2. *O. anazora* (Duclos, 1835). Isla Grande Bay, west Mexico. 3. *O. baetica* (Marrat in Sowerby, 1871). Redondo, California in 25 fathoms. 4. *O. biplicata* (Sowerby, 1825). San Pedro, California. 5. *O. bitleri* Olsson, 1956. Holotype, Panama. 6. *O. brogii* Olsson, 1956. Paratype, Zoritos, Peru. 7. *O. cocosensis* Olsson, 1956, Paratype, Chatham Bay, Cocos Island. 8. *O. columellaris* (Sowerby 1825). Puerto Elena, Ecuador. 9. *O. dama* (Wood, 1828, ex Mawe MS) Puertecitos, Baja California, Mexico.

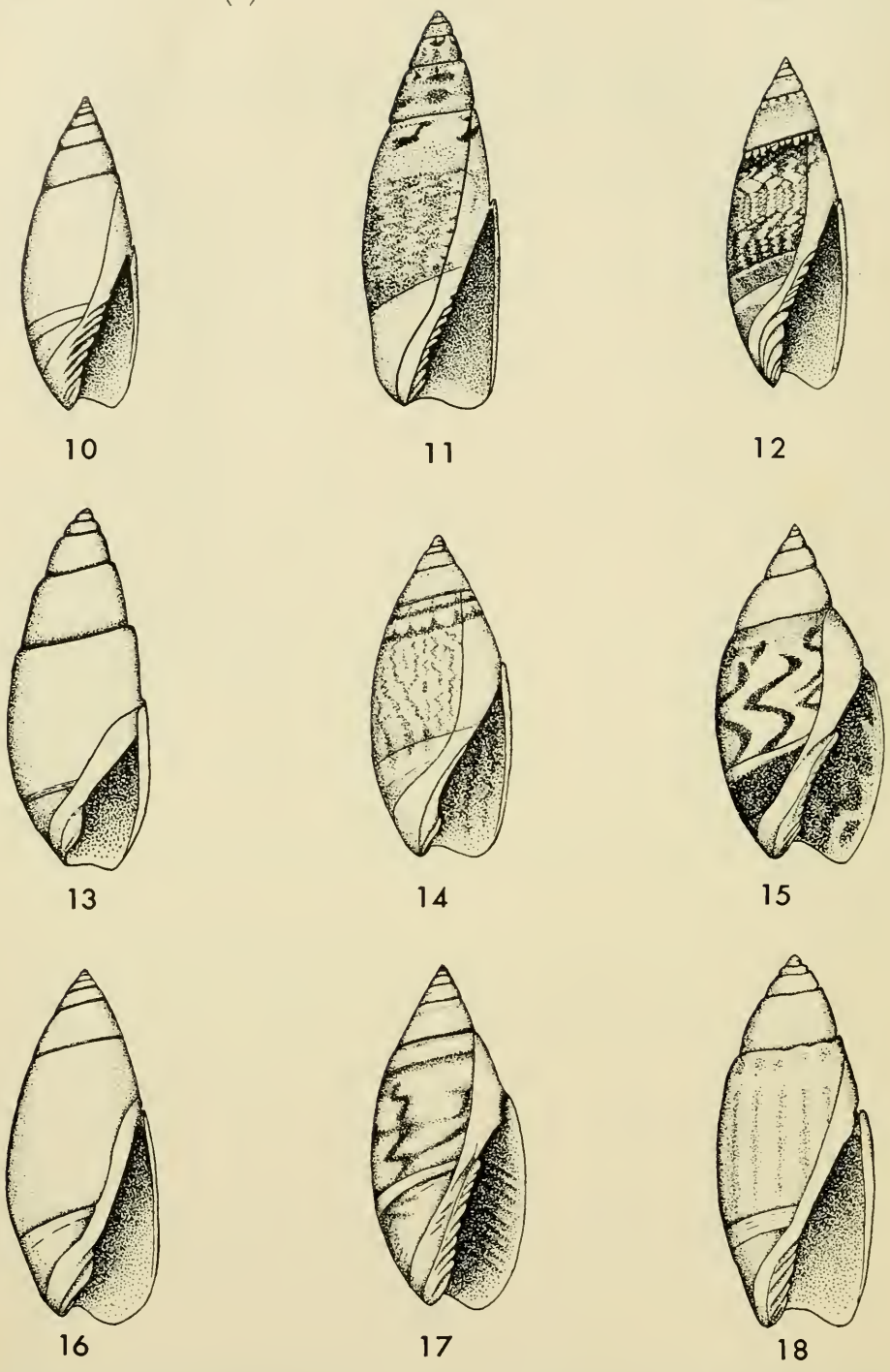

Fig. 10. *Oliveilo drangai* Olsson, 1956. Paratype, San Cristobal Island, Galapagos. 11. *O. fletcherae* Berry, 1958. Aguachale, Baja California, Mexico. 12. *O. gracilis* (Broderip and Sowerby, 1829). Dredged in Mazatlan Harbor. Sinaloa, Mexico. 13. *O. inconspicua* (C. B. Adams, 1852). Holotype, Panama. 14. *O. intorta* Carpenter, 1856. Magdalena Bay, Baja California, Mexico. 15. *O. morrisoni* Olsson, 1956. Holotype, Panama. 16. *O. pedroana* (Conrad, 1856). Knobb Hill, San Pedro Pleistocene. 17. *O. peterseni* Olsson, 1956. Paratype, Zoritos, Peru. 18. *O. rehderi* Olsson, 1956. Paratype, Panama Bay.

the *L. littorea* indicated that the whole assemblage probably dated from approximately the thirteenth century. Clarke and Erskine (l.c.) also reported that radiocarbon analysis of twelve *L. littorea* shells from one of the sites (Indian Point, St. Margaret's Bay, Halifax Co.) gave an age of 700 ±225 years B.P.

Since three kinds of evidence (archaeological, biological, and radio-chemical) each placed the age of the *L. littorea* at approximately 700 years, it was concluded that the specimens were truly pre-Columbian. It was also suggested that Dawson (see Ganong, 1856, 1857) had probably been correct in his opinion that *L. littorea* was not first introduced to North America in the nineteenth century but was an "aboriginal member of the fauna of Acadia."

Since publication of the 1961 reports, three additional radiocarbon dates have become available which affect these conclusions. These, together with zoogeographic correlations, are given below.

Radiocarbon Measurements. During the past few months, it has become evident that anomalous oceanographic conditions may bring about abnormally low radiocarbon concentrations in shells of living mollusks and cause specimens to appear, on analysis, to be older than they really are. Habitats made brackish by the intrusion of fresh water containing fossil carbon may produce false dates. Indian Point is not close to any source of fresh water which would cause such errors, however.

Upwelling of deep oceanic water may also induce incorrect dates. Although there was no reason to suspect upwelling to be operative in Nova Scotia, as a precaution two additional lots of *L. littorea* were submitted for dating to the Geological Survey of Canada.

The first (GSC. 72), collected alive at Indian Point in 1962, produced an activity measurement of 2.21% above the reference standard, i.e., a negative age. This is the "atomic bomb effect" (see Broecker and Olson, 1960), a phenomenon occurring with presently living organisms which has been attributed to recent additions of C^{14} to the atmosphere by atomic explosions. The specimens could not, therefore, be dated.

The second lot (GSC. 71) collected at Yarmouth, Nova Scotia, in 1910, gave a radiocarbon age of 100 ±60 years. This is con-

sidered to be an excellent age correlation and indicates that confidence in the accuracy of the pre-Columbian date is justified.

A third radiocarbon date which is probably more significant than either of the two mentioned above is now also available. The pre-Columbian *L. littorea* shells from Reid Site, Indian Point which gave the date of 700 ±225 years B.P. reported earlier were found in association with other shells and with charcoal. This charcoal has now been dated by the University of Saskatchewan (sample S-153 as 600 ±45 years B.P. and represents a striking confirmation of previous conclusions.

Zoogeographical Correlations. Comparison of the intertidal invertebrate fauna of northwestern Europe with that of Nova Scotia and Maine reveals great similarities. In addition to *Littorina littorea,* virtually all the common, intertidal, rocky coast mollusks of boreal eastern North America also occur in boreal Europe (e.g., see Gislen, 1930). Examples are *Acmaea testudinalis, Buccinum undatum, Hiatella arctica, Littorina obtusata, L. saxatilis, Margarites helicinus, Mytilus edulis, Thais lapillus, Tonicella marmorea, T. ruber,* and *Modiolus modiolus.* With the exception of a few species of *Gibbula* and *Trivia* which occur in Europe but not in North America, the opposite is also true. It is therefore not surprising that such an abundant and widespread European boreal species as *Littorina littorea* should finally turn out to be native to North America as well as to Europe.

Although *L. littorea* has been reported from only two archaeological sites near Halifax, the sites investigated by previous workers in northern New Brunswick and Nova Scotia have not been analyzed in detail from a malacological point of view. It is hoped that future archaeological investigations will provide further information on the pre-Columbian distribution of this species and will contribute to a better understanding of its failure to spread southward beyond the vicinity of Halifax before 1870.

Acknowledgments. The author is grateful to Messers J. S. Erskine of Wolfville, Nova Scotia and Pierre Taschereau of the Nova Scotia Museum of Science for providing material for radiocarbon dating and to the Geological Survey of Canada and the University of Saskatchewan for determining the dates. Useful comments were also given by Drs. W. S. Broecker, J. G. Fyles,

K. W. Ockelmann, R. Robertson, and L. W Scattergood. All this aid is sincerely appreciated, but the author alone is responsible for all conclusions and errors.

Summary

The recent conclusion that *Littorina littorea* was native to eastern Canada in pre-Columbian time has been further substantiated by two new radiocarbon dates. Another radiocarbon measurement made of *L. littorea* collected alive in 1962, gave anomalous results because of the "atomic bomb effect." On the basis of faunal similarities between boreal Europe and boreal eastern North America, one could logically expect *L. littorea* to have occurred in North America before the advent of European Culture.

Note: While this paper was in press, additional, possible ancient specimens of *Littorina littorea* were found at two more localities: (1) in archaeological excavations made in the vicinity of St. Andrews, New Brunswick and (2) in a field near Musgrave Harbour, Newfoundland which may be the site of a raised beach. Radiocarbon dates for this material are now being determined and the search for additional pre-contact specimens is continuing.

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LIVING EXAMPLES OF AURICULASTRA PELLUCENS AND ITS LARVAL HISTORY[1]

By JOSEPH JAY EWALD

Institute of Marine Science, University of Miami, Florida

The living animal of the ellobiid snail *Auriculastra pellucens* (Menke, 1830) is unrecorded in the literature, except for two

[1] Contribution no. 394 of the Institute of Marine Science, University of Miami.

sentences by Dall (1885): "The animal has an entire foot with short tentacles, well-developed eyes, and rather short nuzzle. It was found living by Hemphill and Calkins." Although specimens of this species are found abundantly as fossils in recent blue mud deposits along the Florida east coast from Miami to Key Largo, live specimens have not otherwise been reported.

In April of 1960, a fairly large colony of *A. pellucens* was located in a 75-foot section of mangrove on north Key Largo, Florida, ½ mile east of Route 905 at the right angle bend in the alternate route to Ocean Reef Resort Club. During a period of half an hour approximately 30 snails were found, ranging in size from 11 to 21 mm., of which the majority were of the larger sizes. This area has been revisited several times by this writer and the colony is maintaining itself. During one extremely dry period no animals were found. However, subsequent visits reconfirmed their presence.

The particular section mentioned above is slightly elevated and though surrounded by mangrove swamps which are subject to tidal flooding is seldom, if ever, inundated. The substrate appears somewhat different in structure compared with that found in most mangrove areas of south Florida. It is exceedingly spongy in character and consists of a thick mat of wet peat covered by a few inches of loose leaf mold. Large red mangroves *(Rhizophora mangle)* provide dense shade.

The specimens of *A. pellucens* were diffusely distributed within the leaf mold and none have been found on the surface. A few very large *Melampus coffeus* and some *Assiminea* were also present, but there was a striking absence of other snails, even *Truncatella,* as well as the grapsoid crabs that frequently inhabit mangroves. In the surrounding area, a much greater size range and larger numbers of *Melampus* were found, but no *Auriculastra* were present. One large, live *Littorina angulifera* was noted close by.

In August of 1960, two smaller living individuals of *A. pellucens* were found at a locality several miles away. The substrate at the second locality was composed of rough limestone bedrock covered by a thin layer of loose organic soil, which was dry except for slightly moist concavities under dead wood. The two additional specimens were found in one of these cavities, along with

many semi-transparent empty shells which still retained the periostracum. Both specimens were about one-third maximum size. A very complete growth series of dead shells was obtained, but few of these were over two-thirds maximum size. The protoconchs were uneroded. This area was much dryer than the previous locality, and the difference in the size distribution of shells suggests that it may be less optimal for this species, which is perhaps a chance invader and not firmly established. The area is well within a terrestrial hammock and probably never covered by tides. Dead *Blauneria,* live *Microtralia occidentalis, Truncatella,* and such terrestrials as *Euglandina, Polygyra,* and an unidentified bulimulid were found in the same locality. In subsequent visits to this area, I have been unable to find additional specimens of *A. pellucens.*

The smaller specimens of live *Auriculastra pellucens* have prominent, black eye-spots slightly raised on the dorsal surface of the anterior end of the extended foot. In larger specimens these appear as vague, faint, grey spots due to a thickening of the integument. Because of this they may be easily overlooked. Shells are covered by a tan colored periostracum.

Live snails have been brought back to the laboratory and kept for as long as 3 years in gallon jars, each containing 10 specimens, whose openings are covered by a thin plastic film to permit gas exchange but to prevent excessive evaporation. Wet mangrove leaf mold is frequently added. The snails skeletonize the leaves by eating away the decaying organic material, much in the same way as *Melampus.*

Eggs have been deposited in the jars and these have hatched to produce a new generation of snails. The eggs are contained in capsules in firm, gelatinous chains several centimeters in length and one millimeter in diameter. Each egg capsule is connected to others in the chain by fine gelatinous threads.

Eggs developed into veligers within the capsule. Generally, when the advanced veliger-containing chains were placed in sea water hatching occurred and free swimming veliger larvae were released within 12 hours. Post larvae soon crawled out of the water and sought darkness under leaf mold, just above water level. The veligers and the small snails were negatively phototropic.

The snails of the family Ellobiidae are generally thought to represent the most primitive stock of the Pulmonata. South Florida has probably the largest number of genera and species of these snails in the world, outside of the Philippines. The taxonomy of the group is somewhat confused, and very little is known of ellobiid anatomy and even less of their ecology. The availability of living specimens of *A. pellucens* will permit detailed anatomical studies of the adults and larvae and may perhaps assist in elucidating phylogenetic relationships within the group.

I am indebted to Dr. Harold Harry of North Georgia College, Dahlonega, Georgia, whose enthusiasm and valuable observations have encouraged the writing of this paper.

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ARION IN NEW ENGLAND

By LOWELL L. GETZ and ROBERT H. WAKEFIELD
University of Connecticut, Storrs

The European slug, *Arion fasciatus* (= *A. circumscriptus*) has been introduced into various scattered localities in North America (Burch, 1962; Pilsbry, 1948). As nearly as can be determined, however, it has not previously been recorded from Connecticut, New Hampshire, or western Massachusetts. Recent collections have proven it to be present in these 3 areas.

On 21 October, 1961, several specimens of *A. fasciatus* were collected from under logs at the Campton Campsite, 2 miles N.E. Campton, Grafton County, New Hampshire. The species was quite abundant, but concentrated in a small area of about 20 x 40 yards. Collections made at the same locality in July of 1960 (Getz, 1962) did not contain this species. Since it is now so abundant the species was undoubtedly there at the earlier date, but was overlooked because of its restricted distribution. *A. subfuscus* was also very abundant in this locality. Individuals of both species were collected from beneath the same logs.

Collections made by the junior author revealed *A. fasciatus* to be abundant on the campus of the University of Connecticut, Storrs, Tolland County, Connecticut. Subsequent collecting in

the vicinity of Storrs showed this species to be abundant in nearby gardens, pastures, and abandoned fields. In certain instances, it has become a garden pest (R. M. DeCoursey, personal communication). Although estimates of the population densities were not made, the slugs in some of the fields appeared to be at least as abundant as they were in an abandoned field in southern Michigan (Getz, 1959). Therefore, *A. fasciatus* apparently is well established in the vicinity of Storrs, Connecticut. A single specimen of this species was also collected in Lime Rock, Litchfield County, Connecticut by John R. Oppenheimer.

A. fasciatus has been recorded from the eastern regions of Massachusetts (Pilsbry, 1948); none has been reported from the western portion of the state, however. Specimens of this species were collected on 4 July, 1962, at a garbage dump 2 Mi. N. Petersham, Worcester County, Massachusetts.

The locality records reported above resulted from more or less sporadic spot collecting; no intensive search was made for *A. fasciatus*. Probably concentrated collecting would reveal this species to be rather widely distributed throughout the southern New England area. Its abundance in certain situations indicates it is becoming one of the more important components of the terrestrial molluscan fauna in this region.

On 10 April, 1962, the senior author collected a single specimen of *Arion ater* from under the leaf litter in a seepage area on the University of Connecticut campus. This species has been recorded in North America only from Newfoundland, Quebec, Maine, Michigan, and Oregon (Pilsbry, 1948). An intensive search was made of the general area where the specimen was obtained, but no additional specimens were discovered.

The area is adjacent to a cemetery. Possibly, therefore, *A. ater* was carried into the cemetery on potted plants and may not represent an established colony. Flowers are not discarded in the site where the specimen was collected, but the slug could have easily crawled there from the cemetery. Burials were made in the cemetery on 20 and 22 March (approximately 50 yards from where the specimen was obtained). Possibly the slug could have been brought in at one of these times (it was not possible to establish that potted plants had been placed on either of these graves). Because of the size of the specimen (35 mm when con-

tracted) more likely it was carried into the area at an earlier date (the preceding year, perhaps). Because of the dense ground cover in the seepage area, there is still the possibility that a small breeding colony of *A. ater* is present. The area will be kept under observation to determine if this species has become established.

SUMMARY

Breeding colonies of *Arion fasciatus* have been discovered near Campton, New Hampshire, Petersham, Massachusetts, and in Lime Rock and Storrs, Connecticut. A single specimen of *Arion ater* was collected in Storrs, Connecticut.

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NORTHERN RECORDS OF GASTROCOPTA PROCERA[1]

BY NORMAN J. REIGLE

Museum of Zoology and School of Natural Resources

University of Michigan

The northern extent of the range of *Gastrocopta procera* (Gould), generally considered a southern species, has been somewhat confused. The general range of this species has been defined by Pilsbry (1948) and more recently an "approximate distribution" map was provided by Leonard (1959). Pilsbry also noted the northern records of Sterki and F. C. Baker. The records for *G. procera* in the peripheral states of its range have in general been listed by the following: MacMillan (1949) West Virginia; Taft (1961) Ohio; Goodrich and van der Schalie (1944) Indiana; Baker (1939) Illinois; and Pilsbry (1918) and Roscoe (1954) South Dakota.

A study of the pupillid collection of the Univesity of Michigan Museum of Zoology has yielded six lots which extend the range in four states and help to clarify the northern periphery of the range. The range here defined also includes the two questionable subspecies *sterkiana* Pilsbry and *mcclungi* Hanna and John-

[1] Supported (in part) by a research grant (NSF-G17653) from the National Science Foundation, Washington, D. C.

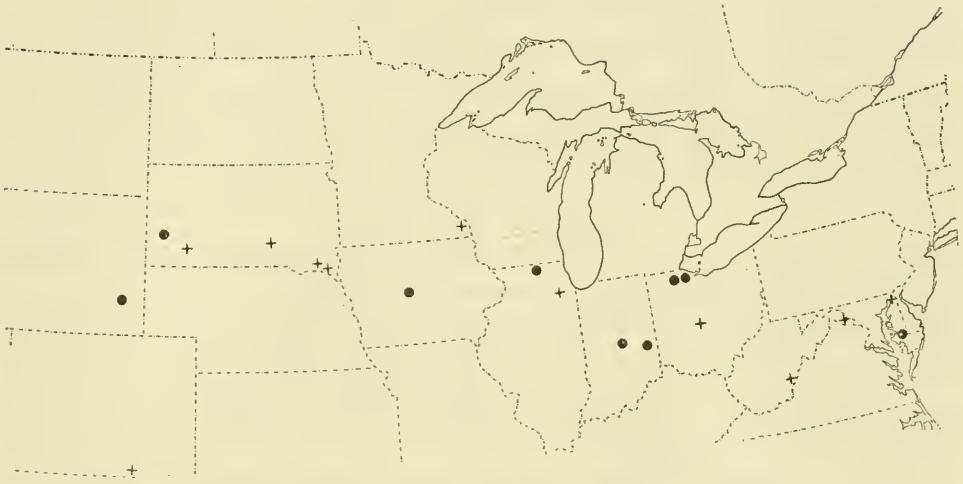

Fig. 1. Peripheral northern records for *Gastrocopta procera* (Gould).

ston, the validity of which has been questioned by Franzen and Leonard (1947). A summary of the previous records and additions of the new records would seem to indicate a more northern range for the species than was formerly considered. The accompanying map (Fig. 1) presents records which establish this range. The circles represent records from material examined by me; plus signs represent localities obtained from the literature. The new locality data are given in detail below with the University of Michigan Museum of Zoology numbers given for each lot.

Ohio: 56608 — drift of Toussaint Creek, East of Genos, Ottawa County — April, 1933. Goodrich, Archer and van der Schalie, Collectors.

106942 — two miles South of Perrysburg, Wood County. C. Goodrich, Collector.

Indiana: 211751 — Indianapolis, Marion County. P. L. Marsh Collection (from Kent Science Institute).

Illinois: 106951 and 161281 — Winnebago County. W. A. Marsh, Collector.

Iowa: 168119 — Ledges State Park, near Boone, Boone County, June 7, 1947. A. La Rocque and H. van der Schalie, Collectors. Barry Miller (personal communication) has examined a large number of lots of *G. procera* from north west Iowa in the former collection of B. Shimek which is now in the United States National Museum.

Wyoming: 68639 — Hartville Canyon, Guernsey, Platte County, Walker Collection.

211746 — drift, L. Guernsey, near Guernsey, Platte County, August 29, 1941. P. L. Marsh Collector. This is apparently a new state record for Wyoming (see Beetle, 1961).

Acknowledgments. I would like to thank Mr. Barry Miller for allowing me to look over the records he compiled from the collections of the United States National Museum; Dr. John B. Burch for helpful suggestions; and Dr. Henry van der Schalie for permission to study material under his charge.

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EXTENSION OF RANGE OF ASIATIC CLAM TO CINCINNATI REACH OF THE OHIO RIVER

By LOWELL KEUP, W. B. HORNING, WILLIAM M. INGRAM*

Recent investigations of benthic fauna in the Cincinnati reach of the Ohio River revealed the presence of the Asiatic Clam, *Corbicula fluminea* (Müller), as a new component of the benthos. Initial collections of this clam were made by William M. Ingram, W. B. Horning II, and Jack Geckler on July 6, 1962, at Cincinnati, Ohio (Ohio River Mile 465.6). A portion of the original sample was forwarded to the U. S. National Museum where Dr. J. P. E. Morrison confirmed initial identification.

* Biologists, Field Operations Section, Technical Services Branch, Division of Water Supply and Pollution Control, Robert A. Taft Sanitary Engineering Center, Public Health Service, Cincinnati, Ohio.

W. B. Horning II made a second collection of Asiatic clams on August 6, 1962, along the Kentucky shore of the Ohio River (Ohio River Mile 468.0). Subsequently, samples collected September 5 and 6, 1962, revealed the Asiatic Clam to be a significant member of the benthic fauna from near Cincinnati downstream as far as Warsaw, Kentucky, (Ohio River Mile 530.0) where studies were terminated.

A summary of the known American distribution of the Asiatic clam was reported by Ingram (1959). This clam probably first arrived in the Pacific northwest, and after becoming established at various localities along the Pacific Coast, next appeared in the Tennessee River (Sinclair and Ingram, 1961). Further distribution of the Asiatic clam in the Tennessee and Cumberland Rivers was reported in a life history by Sinclair and Isom (1961). In addition, Sinclair and Isom mention a tentative record of the Asiatic clam for the Ohio River at Paducah, Kentucky.

Asiatic clams were not found in benthic samples collected as late as January 1960 from the Ohio River, from Pittsburgh, Pennsylvania, downstream to Mound City, Illinois (Jackson and Wiese, 1962). By September 1962, however, this clam had invaded the Cincinnati reach of the Ohio River and had become a significant member of the benthic community (Table 1). The upstream limit of its distribution in the Ohio River is not known.

In addition to the natural history interest of the migration of this species, the potential of its becoming a nuisance in irrigation and water supply systems has already been depicted (Ingram, 1959). The impact of its rapid population growth and development on the ecology of an area is also of interest since its numbers soon predominate in a typical sample (Table 1). Major changes in benthic communities may be influenced through its competition with other invertebrates for space and food. Utilization of the clam by fish and waterfowl may prove its value to wildlife.

The writers believe these organisms invaded the Cincinnati area about 1960. The population consists of a large group of individuals 2-5 mm. long, and another less numerous group of individuals 10-20 mm. long (anterior-posterior length). A few empty shells of a larger size (30 mm.) have been found. The size-class distribution of the Asiatic clam indicates three "year-

TABLE I

Mean Number of Organisms Sampled Per Square Foot
September 5 and 6, 1962

Organisms	Ohio River Mile				
	461.5	466.0	471.5	484.0	530.0
Corbicula fluminea	27.2	20.2	28.5	72.0	222.4
Clams (Unionidae)					1.6
Clams (Sphaeriidae)					31.2
Snails (Operculate)		0.3		20.4	24.8
Snails (Pulmonate)				0.3	
Leeches (Annelida)				1.7	
Tubificidae (Annelida)	4.0	0.3	4.6	3.7	11.2
Tendipedidae (Diptera)	27.2	3.2	1.7	2.6	1.6
Ceratopogonidae (Diptera)	0.8				
Ephemeroptera	1.6				
Anisoptera (Odonota)	0.8				

classes" are probably existing in the Cincinnati reaches of the Ohio River — 1960, 1961, and 1962.

Identification of the Asiatic clam is not difficult. A significant characteristic, easily recognizable in the field, is the distinct ridged sculpturing of the shell. The ridges are obvious on the smallest specimens collected from the Ohio River (less than 1 mm., anterior-posterior length).

Presumably, Asiatic clams will eventually extend their range much farther. Barriers to their distribution are not obvious, and once established, a population grows rapidly. Generally, they are found in sandy or on sand and gravel areas; however, Ohio River bottom samples with a high percentage of silt have also contained significant numbers. Biologists in neighboring areas should remain alert to their appearance.

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MOLLUSKS FROM HARDWOODS OF THE CHIGNECTO ISTHMUS

By E. J. DIMELOW

In a previous paper (Dimelow, 1962) the occurrence of the slug *Philomycus carolinianus flexuolaris* was noted in the Maritime Provinces of Canada (near Fenwick, N. S.). The slug *Pallifera dorsalis* and snails uncommon in the "maritimes" (*Mesodon sayanus, Anguispira alternata*) were also found at this site.

An attempt was made to find out whether the *Philomycus* is likely to become extinct in this area. The deciduous wood in which it was found lies at a height of 300-450 feet, is about one square mile in extent, but gives way to conifers at lower levels at a point where several streams run down the hill slope to St. George's Brook and the ground becomes wet underfoot. Sugar mapling is still carried out in half of the wood and this involves the cutting down of trees which are dead or not of the right kind. Some logs are carried to a shed and stored till spring, then burnt to evaporate the maple syrup. At the present time, the wood cutting and tidying are not very great. The forest contains a fair number of old trees. Large fallen decaying trunks are not uncommon and the *Philomycus* can be found sparingly in these. The other half of the wood, which lies mainly at a height of 400 feet next to the highway, has become an official picnic site. Here the trees are rather far apart and fallen trunks are cleared away, so that the slug is not able to extend into this zone. Officials of the Department of Lands and Forests for Nova Scotia have, however, kindly consented to see that the tidying up is not quite so thorough.

A few more plants found in the wood were offered to specimens of *Philomycus* as food under laboratory conditions in early summer. These were *Trillium undulatum, T. cernuum, Rubus pubescens, Smilacina racemosa, Polygonatum pubescens, Pyrola elliptica, Circae alpina.* Young *Trillium* leaves were eaten by both *Philomycus* and *Pallifera*. Thus in nature *Philomycus* may not feed entirely on fungus and lichens.

From Route 2a near Maccan a larger hardwood about two square miles in extent at a height of 100-350 feet, can be seen on the St. George's Brook slope. This forest is partly continuous with the woodlands at Fenwick, but is best approached from the village of Chignecto. Its slopes are well drained. Trees present are sugar maple, beech, yellow birch and white ash. The slugs *Pallifera dorsalis, Deroceras reticulatum, D. laeve, Arion circumscriptus* are found here along with the following snails:

Euconulus fulvus (Müller)
Zonitoides arboreus (Say)
Striatura exigua (Stimpson)
Striatura ferrea (Morse)
Discus cronkhitei cronkhitei (Newcomb)
Discus cronkhitei catskillensis (Pilsbry)
Strobilops labyrinthica labyrinthica (Say)

By taking gravel roads to Salem, it is possible to penetrate higher level deciduous woodland (400-450 feet) round the source of St. George's Brook. Here the ground is more rocky and there is less leaf litter. White birch trees predominate over sugar maple and plants like *Comptonia peregrina* (sweet fern), *Kalmia angustifolia, Cornus canadensis* are common. Even so the same slugs and snails are to be found as at the 250 foot level with the exception of *E. fulvus, D. cronkhitei cronkhitei* and *S. labyrinthica.* In addition a single shell of *Retinella electrina* (Gould) was collected. Fallen birch stumps which are rather narrow in diameter shelter the mollusks. One specimen of *Zonitoides arboreus* contained the pupa of a parasitic sciomyzid fly which was submitted to Dr. C. O. Berg and identified by him as belonging possibly to *Pherbellia albovaria.*

All the snails found at these two additional levels extend to Cape Breton, Nova Scotia, according to Macmillan (1954).

Hardwoods at Collingwood, East Mapleton, South Brook in the Springhill area lying at a height at 350-550 feet were searched for *Philomycus, Mesodon* and *Anguispira.* Also similar forest on the slopes of Indian Mountain near Moncton, New Brunswick, was investigated. These woods all contained *D. reticulatum, D. laeve, A. circumscriptus, Z. arboreus* and *D. cronkhitei cronkhitei. Pallifera dorsalis* was collected near Stiles Village at a height of 500 feet on Indian Mountain and not anywhere else. It is not easy to explain why the St. George's Brook woods contain more

slugs and snails than these others. In all cases the forest is mature, the soil well drained and the leaf litter deep. Conifers normally extend up to 300 feet so the hardwood areas are isolated from each other for the most part. Perhaps the high altitudes, cold winter temperatures and steep slopes (in some cases) are unfavourable. In addition sugar mapling is carried out extensively and sometimes, as for example at South Brook, nearly all fallen trunks which could shelter mollusks are cleared away. Since not all maple woods are as tidy as this, other factors must be held partly responsible.

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OBSERVATIONS OF A COLONY OF MAGNIPELTA

By ROYAL BRUCE BRUNSON and NILES KEVERN
Montana State University

Two articles have appeared in the literature concerning *Magnipelta mycophaga* Pilsbry. This genus and species was described by Dr. Henry Pilsbry (1953) from an immature specimen which was found by Dr. and Mrs. R. T. Orr in the Selway primitive area of Idaho. This area was reached by going over the Bitterroot Mountains on the Lolo Creek Road from Lolo, Montana. At that time the road was a deadend road terminating in a primitive white cedar forest. The road now connects Lolo, Montana and Lewistown, Idaho, as U.S. 12. The second article concerning *Magnipelta* was a joint contribution of Pilsbry and Brunson (1954). This report was based on 12 adult specimens from the Deer Creek (Missoula) colony. Complete descriptions of the animal's anatomy and some natural history notes were recorded, along with photographs of the animal.

The present study is based on the Deer Creek colony, a colony found at an elevation of 4,150 feet on the east side of Mount

Sentinel in the Sapphire Mountains. As far as could be determined, the animals are limited to an area of approximately 440 yards long adjacent to Deer Creek. The general habitat lies between the creek and a small gravel road which parallels the creek at a distance of 15 to 20 feet. No specimens were found above the road or on the north side of the creek. During April and the first half of May, the vegetational pattern was a moderate covering of evergreens, chiefly spruce and fir, with the undergrowth only beginning to leaf out. During the latter half of May growth was very rapid (Missoula had one of the warmest springs on record). By June the area was completely covered by dense undergrowth, except under concentrations of evergreens.

In addition to the vegetation, many other factors contribute to produce a cool, somewhat moist gross habitat. Deer Creek, fed by springs and melting snow, is cool; the water temperature on July 20 was 48°F. at the time the air temperature was 77°F. The creek lies in a V-shaped valley, the sides of which are covered with tall trees. The sun strikes the habitat area only in the middle of the day. Observations at 11:00 A.M. on some of the warmer days showed that the ground and lower foliage was still wet from dew of the previous night.

Within the gross habitat, there were many fir and Ponderosa logs. Large pieces of bark from the Ponderosa logs provided excellent niches for the slugs. Some pieces of bark were "planted" to insure a greater distribution of the animals in the gross habitat and to insure a more accurate count. *Magnipelta* was also found under small logs, loose stones, and around the grass-covered periphery of the more tightly adhering stones. On cool, moist days the slugs were found roaming over the ground and lower foliage. On warmer days there was no evidence of movement. Therefore, it is assumed that most of the movement and feeding during the warm period occurs at twilight or night. Further evidence for this assumption was the large amounts of fresh green faeces which could be seen early in the morning. These faeces formed trails throughout the habitat.

The area was studied from the first of April, 1957, to the last of September, 1957. The first slug (14 mm) was found on April 29, when snow still covered most of the ground. The air

temperature was 72°F., and the ground temperature near the slug was 57°F. In the area were found 3 *Allogora,* 1 *Triodopsis,* and several *Discus.*

May 5 was a cloudy day with showers. Most of the patches of snow were gone. The air temperature was 58°F. and the ground 56°F. Only one specimen of *Magnipelta* was found. Many *Allogona* were found, and about 30% of these were copulating.

Twelve specimens were found on May 10. The sizes of the 12 extended animals in millimeters were: 20, 55, 20, 67, 46, 23, 42, 15, 36, 42, 39 and 27. Four of the 12 specimens were found under rocks, one under bark, four under logs, and three under rotted wood. The air temperature was 74°F. The temperatures of the habitats ranged from 53°-58°F.

Eighteen slugs were found on June 1. Nine large specimens were found under a board, 6 feet long and one foot wide. The other nine were found under logs and a small board. Temperatures of the habitat-niche ranged from 56°-59°F. with the air being 78°F.

June 7 was a cloudy, cool (64°F.) day. With the help of Dr. William B. Hebard, of New York University, greater numbers of *Magnipelta* were found on this day than on any other day of the year. Eighty-six animals were located. Ground and niche temperatures ranged from 57°-61°F. More than half the slugs were moving around under a covering of plants on the open ground. The rest were found under and near rocks, logs, and bark. Only 4 slugs were found under the board that had 9 on June 1, an indication that the slugs move about freely when weather permits. Of the 86 animals collected, less than 10 were smaller than 20 mm. Twenty slugs were measured. The smallest was 14 mm. long, and the largest was 80 mm. Both were fully extended. The average length of the 20 extended animals was 43 mm. Comparisons of the extended and contracted animals were made. The largest slug measured 80 mm. long, 12 mm. wide, and 11 mm. deep when fully extended. When contracted, it measured 40 mm. long, 20 mm. wide, and 17 mm. deep. Undisturbed movement of the slug was 14 inches in one hour.

Twenty large *Magnipelta* were found on June 23. It is interesting to note that no animals were found in areas which were occupied on previous dates. Presumably most had migrated into

the deep areas of rock pilings bordering the road.

No counts were made on June 30, and July 6. Instead, efforts were made to mark the animals and their slime trails. Some slugs were injected with eosin in the hopes that the resulting slime trails would be colored. The effects of the injection were quick movements and short colored slime trails. None of the animals was killed by the injection. All marks were sloughed off by the ensuing slime.

A heavy rain fell on the morning of July 14. The area was therefore very wet during the afternoon. The air temperature dropped to 62°F. Although no counts were made on this day, approximately ½ of the slugs were in their habitat niche and the other ½ were moving around on the ground under the foliage. This is the same free movement as that which occurred on the other wet, cloudy days.

The temperatures of the habitat niches on July 20 and July 26 ranged from 50°-60°F. The air temperature on both days was in the high 70's, and the relative humidity was very low. It was not surprising, therefore, to find but few specimens during this period. Four slugs were found on July 20, and two were found on July 26.

Three animals were found on August 4. Most of the habitat was dry and deserted. Two specimens were found under rocks, and one under bark. The temperature under the bark was 68°F., and the slug was contracted and showed no signs of activity.

The relative humidity was between 10 and 20 percent during the month of August. No slugs were found between August 4 and September 1. However, on September 5, cool weather returned. Air temperature of the habitat was 66°F. Temperatures of the habitat niche ranged between 60° and 68°F. Ten specimens were found, under logs, rocks, and bark. The size of the extended animals ranged between 20 and 70 mm. Two specimens were shorter than 40 mm. in length.

Snow fell on September 22 and much of it remained on the 23rd, when only one large slug was found. The animal was very inactive. It proved to be the last animal to be found that year.

From the data obtained, evidently *Magnipelta* prefers a cool, moist habitat with the temperature between 53° and 60°F. The optimum season in the Deer Creek area occurs bteween May 10

and July 26. The green coloring of the faeces indicated that the food of the slug in this optimum season is green plants or moss, both of which are plentiful in the area. What is eaten, when the animals leave the main area is unknown. One might deduce that at the time the slugs are deep in the rocks (if that is the place to which they go) their diet must consist of fungi.

Careful observations throughout the summer failed to shed any light as to the eggs of this animal or the very young. The length of all animals measured throughout the summer ranged from 14 mm. to 80 mm. One might surmise, after studying the habitat for a year, that the eggs and young occur in the deep-rock area, much the same as do the snails which inhabit the talus slides in Western Montana. To be certain of the eggs and young, one should raise the animals in captivity.

There was no evidence of predation on *Magnipelta*. Only four animals were found dead. One had drowned in a small pool of water. The other three had died as a result of either having been stepped on or hurt during the process of replacing the habitat.

From evidence obtained, apparently the slugs do not move much during warmer days, or if they do move, they may have a tendency to return to the same place. Under one board 9 large slugs were found. The following week there were 9 large slugs under the same board. Eight large slugs were present in the same place the third week. To cite another case, one large slug consistently appeared under the same rock over most of the period of observations. It was either the same slug or one exactly the same size.

It is hoped that in the future methods will be found to mark the slugs and that a suitable method found for studying the deep rock area so as to shed light on aging, movement, and egg laying.

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A METHOD OF TAGGING CHANNELED WHELKS

By WILLIAM N. SHAW

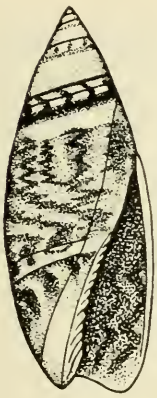
Fishery Biologist (Research), U. S. Fish and Wildlife Service,
Bureau of Commercial Fisheries Biological Laboratory, Oxford, Maryland

Both the channeled whelk, *Busycon canaliculatum* (Linné), and the knobbed whelk, *B. carica* (Gmelin), are known predators of oysters. Carriker (1951) found that the predation rate for both species of *Busycon* in aquaria ranged from 0.8 to 2.7 oysters (1.0 - 7.8 cm in shell height) consumed per whelk per week. In field studies at Oyster Pond River, Chatham, Massachusetts, Shaw (1960) found that *B. canaliculatum,* placed in a wire cage with oysters greater than 7.6 cm. in height, consumed 0.3 oysters per whelk per week.

Shaw (1960) also noted in field observations that the majority of channeled whelks could be removed from oyster bottoms in the spring in wooden traps baited with partly crushed horseshoe crabs, *Limulus polyphemus.* The high rate of capture on oyster beds at the beginning of each trapping season indicated that the whelks had moved in from other areas during the previous year.

With the intent of tracing the movements of the channeled whelk, I tagged 100 individuals and released them at the mouth of Oyster Pond River, about ¼ mile down stream from the nearest oyster bed, on June 10 and June 13, 1960. The purpose of this note is to describe the method of tagging and the direct effects of the tag on the whelk.

Each whelk was tagged as follows: Large polyethylene tubing was cut open and rectangles, ¾ x ½ inch, were cut from this. A number was stamped on and a hole was punched in each rectangle. Two holes, 2 mm. in diameter and 10 mm. apart, were drilled through the shell of the whelk about one inch inside the outer lip to the body whorl and just beneath the sutural canal. A piece of polyethylene tubing, 1 mm. in diameter was looped through the holes in the shell and through the hole in the tag. The tag was then tied in place by joining the ends of the tubing with a standard square knot (figs. 1 & 2, A & B). Prior to release of the whelks, the shell height (spire tip to siphon tip) and maximum diameter (outer lip to the opposite



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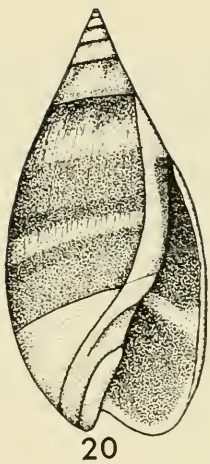

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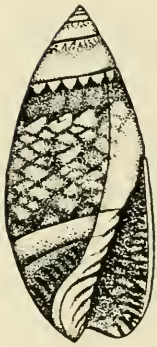

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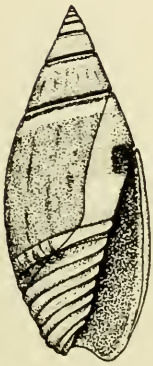

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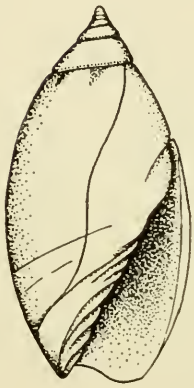

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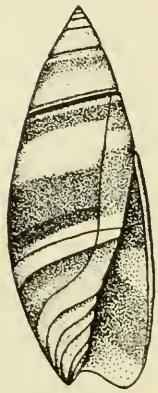

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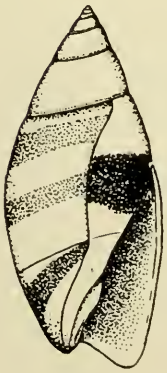

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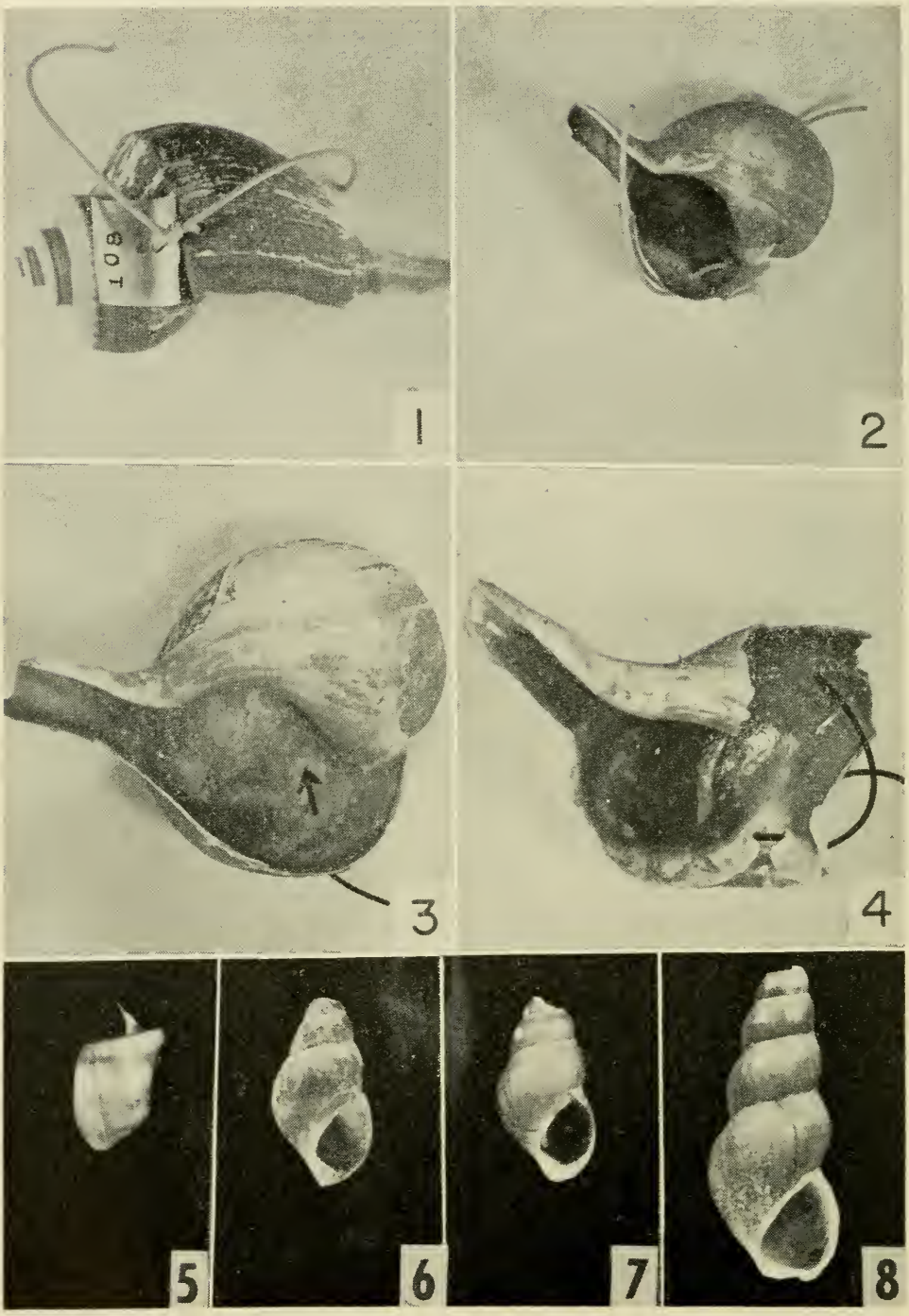
Fig. 19. *Olivella riverae* Olsson, 1956. Paratype, Zoritos, Peru. 20. *O. semistriata* (Gray, 1839). Panama Bay. 21. *O. tergina* (Duclos, 1835). Mazatlan, Sinaloa, Mexico. 22. *O. volutella* (Lamarck, 1811). Panama Bay. 23. *O. walkeri* Berry, 1958. Holotype, Guaymas, Sonora, Mexico. 24. *O. zanoeta* (Duclos, 1835). Aguachale, Baja California, Mexico. 25. *O. zonalis* (Lamarck, 1811). Santa Cruz. Nayarit, Mexico. *Species dubiosa*. 26. *O. gracilis gaylordi* Ford, 1894. Paratype, Gulf of California. 27. *O. versicolor* (Marrat in Sowerby, 1871). Type of Marrat, Liverpool Museums.



Figs. 1-4, *Busycon canaliculatum* (Linne). 1 & 2: Showing attachment of the tag. 3: Arrow points to area where inner loop of plastic tubing has been covered over with shell. 4: New shell partially covering inner loop of plastic tubing. Figs. 5-8, *Goniobasis*. 5: Fragment of body whorl from RB285. 6: From RB102. 7: *G. laurae* Goodrich, paratype. 8: *G. interioris* Goodrich, paratype.

side) of each was measured to the nearest millimeter.

In February 1962, two tagged whelks were recovered. The empty shell of one was found on the beach at the mouth of Oyster Pond River just opposite the point of release. The broken shell of the second whelk with the tag intact was found by an oysterman on his barge one mile up river from the area of release. Probably this individual had been dropped on the barge by a seagull. Since I do not know where the seagull originally found the whelk, the exact movement of this snail is not known.

The following changes were noted on the shells of the two whelks: In one shell the loop of the plastic tubing inside the body whorl had been completely covered by new shell thus cementing the tubing in place (fig. 3). This whelk had increased in shell height from 158 mm. to 172 mm. and in maximum diameter from 90 mm. to 96 mm. In the other whelk the inner loop of plastic tubing was only partially covered with new shell (fig. 4). Probably the latter whelk died or was killed before completely covering the tubing. Since this individual was not intact, shell measurements could not be obtained.

Probably the loop of tubing inside the shell irritated the mantle of the whelk stimulating the snail to secrete shell over the tubing. After the loop was covered, the tubing became sealed in place and probably would remain there throughout the whelk's life.

These observations suggest that this is a suitable method of tagging whelks for studies of their growth rates and migration patterns in the field.

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Shaw, W. N. 1960. Observations on habits and a method of trapping channeled whelks near Chatham, Massachusetts. Special Scientific Report. Fisheries No. 325:1-6.

NOTES AND NEWS

Dates of the Nautilus. — Vol. 76, No. 1, pp. 1 to 38, iii, pls. 1 & 2, was mailed July 5, 1962. No. 2, pp. 39 to 74, iii, pls. 3 to 5, Nov. 14, 1962. No. 3, pp. 75 to 114, Jan. 17, 1963. No. 4, pp. 115 to 152, pls. 6 to 11, April 19, 1963 — H.B.B.

Corbicula fluminea (Müller) in Louisiana.—The rapid spread of this mollusk is a dramatic one. Since it was first observed in the United States in 1938 it has shown a phenomenal capacity for dispersal in that it has gone from the Columbia River in Washington down into the Willamette River, Sacramento River, San Jaoquin River, the tributaries of all these, into the Colorado River drainage and irrigation systems, and into the Gila River in Arizona. Then it appeared to skip over into the TVA system where it was first reported from Paducah, Kentucky, on the Ohio River. Since then it has rapidly spread into the Tennessee River, the Cumberland River, and the Green River. It has been observed in abundance in various localities along all these rivers.

An excellent review of the whole *Corbicula* dispersal through the United States plus a discussion of its life history, ecology, and general habits can be had by reading the paper, "A Preliminary Report on the Introduced Asiatic Clam Corbicula in Tennessee" (R. M. Sinclair and B. G. Isom, Tennessee Department of Public Health, Tennessee Stream Pollution Control Board. 1961).

Now *Corbicula fluminea* is beginning to be found in streams along the Gulf Coast. Louisiana Wild Life and Fisheries (Water Pollution Control) biologists, taking bottom samples in the Calcasieu River at mile 66 in Calcasieu Parish, Louisiana, found it in October, 1961. The same biologists also collected it in Assumption Parish, Louisiana, on Bayou Magasille in April, 1962 and in Bayou Sorrel at the locks in Iberville Parish in May, 1962.

Within less than 25 years this small, slow-moving, bottom-dweller has spread over much of the United States. This once again is evidence of the hazards involved in accidental or deliberate biological introductions.—Dee Saunders Dundee and Walter J. Harman, La. State University, in New Orleans and Baton Rouge.

The range of Succinea ovalis.—Walker (Terr. Moll. Alabama. Univ. Mich. Mus. Zool. Misc. Publ. no. 18. p. 167. 1928) reported *Succinea ovalis* Say from several localities in southwestern Alabama. Having collected rather extensively in this part of

Alabama without finding it, probably these records were based on misidentifications. Only one lot of *Succinea ovalis* was found in the University of Michigan collections from Alabama. These were from Mobile. The one lot from the Clapp Collection of the Carnegie Museum labeled *S. ovalis* proved to be *Catinella texana* Hubricht. The Mobile specimens are probably a case of mixed labels. Pilsbry's record from Smith Island, Brunswick Co., North Carolina (Land Moll. N. Amer. 2: 803) is probably also erroneous.

Succinea ovalis is a more northern species. Its southern limit is from Maryland to Kentucky, but ranging southward in the mountains as far as the Great Smokies. On the floodplain of the Mississippi River, it ranges as far south as Memphis, Tennessee. In central Missouri it is not known from south of the floodplain of the Missouri River. It is known from as far west as Doniphan Co., Kansas, Brown Co., Nebraska, and Devil's Lake, North Dakota.—Leslie Hubricht.

Corbicula fluminea in the Mobile River.—*Corbicula fluminea* Müller was found abundant during the spring of 1962 in the Mobile River at the Riverview Fishing Camp, 1 mile north of Bucks; and in smaller numbers in the Mobile River at Chastang Bluff, east of Chastang, Mobile Co., Alabama. It was not found in the Tombigbee River at the Ft. Stoddard Fishing Camp, east of Mt. Vernon, Mobile Co., Alabama; nor in the Tombigbee River, east of McIntosh, Washington Co., Alabama.—Leslie Hubricht.

Twisting behavior in mesodon thyroidus—In the field, when pulled by the shell from a surface to which it tightly adheres, an occasional *M. thyroidus* reacts with a violent and repeated twisting of the body from side to side, a response that, were the shell free and the foot attached to a surface, would result in rotation of the shell upon the body. Such a twisting of the shell upon the body has been observed upon occasion in laboratory animals burdened by other snails clinging to their shells. It is therefore possibly a response to unusual tensions upon the body and might contitute a defense reaction or, in progression through the litter, might aid in extricating the animal from tight quar-

ters. This behavior is undoubtedly allied to the similar, but chemically elicited, escape responses of many marine gastropods, described by Kohn (1961, Am. Zoologist *1:* 291-308).—Walter C. Blinn, Michigan State University, East Lansing.

Brachystyloma Weisbord a synonym of Anachis H. & A. Adams (Columbellidae).—Three shells from "red pebbly sand" in the Abisinia formation (Pleistocene?) of Venezuela have been described by N. E. Weisbord (1962, Bulls. American Paleo., *42* (193):27-28, 335-337, pl. 29, figs. 23-24) as a new species in a new monotype genus provisionally placed in the Columbellidae: *Brachystyloma caribbeana.* Examination of the holotype (Paleont. Res. Inst. no. 26244), graciously loaned to me by Dr. K. V. W. Palmer, has confirmed a suspicion elicited by the illustrations that *Brachystyloma* is a worn and badly broken columbellid, probably the abundant and variable *Anachis* (*Costoanachis*) *hotessieriana* Orbigny (see R. T. Abbott, 1958, Acad. Nat. Sci. Philadelphia, Monogr. 11, pp. 68-69) or a closely related species in the same subgenus. The whole shell has been abraded, and the outer lip has been broken back almost one half a whorl. The anterior siphonal canal has also been broken, and the "deep excavation under the base of the columella" (the main generic character of *Brachystyloma*) is an erosional feature that would be found only in broken and abraded shells. Accordingly, *Brachystyloma* Weisbord (1962) is a subjective junior synonym of *Anachis* H. & A. Adams (1853) and of *Costoanachis* Sacco (1890). The holotype of *Brachystyloma caribbeana* is 3.2 mm. wide, not 4.9 mm. as stated.—Robert Robertson, Academy of Natural Sciences of Philadelphia.

Anisus Studer (1820a: 91) was proposed to include *Planorbis* O. F. Müller (1774: 152) and *Physa* Draparnaud (1801: 52). In my judgment, the first valid selection of a type species was made by Herrmannsen (1852: 9), who selected *Planorbis umbilicatus* Müller, which would make it a synonym of *Planorbis,* type (Cf. opinion 335) *P. planorbis* (Linné). However, J. E. Gray (1847b) had made 3 previous designations in one publication. On page 180, he listed *"Anisus,* Studer" in the synonymy

of *Physa,* for which he designated *Physa fontinalis* (Linné) [Cf. opinion 94]. Also on p. 180, he selected *"H[elix] spirorbis"* [Linné] as the type of *"Anisus* Fitz., Studer" [Fitzinger, 1833: 111, who did not include that species]. Finally, to make matters worse, on p. 181, he designated *"P. olivaceus"* [1827] for the type of *"Anisus,* Beck" [Anisi, 1837: 120], another misusage. If any of these 3 be valid, which I doubt, it is the first one.

On the other hand, Pilsbry (1934: 62) accepted Gray's 2nd choice. Since he was followed by F. C. Baker (1945: 55), this usage has become rather general. Actually, the valid name for this subgenus of *Gyraulus* is *Omalodiscus* Benson (1855: 127) for which the first type selection, so far as I am aware, was that of Hannibal (1912: 153, in a discussion of *"Planorbis"*), who stated *"Omalodiscus,* Benson, 1855 (*P.[lanorbis] vulgaris* Swains. = *H.[elix] vortex* L., type by substitution)," which clearly was Benson's intent, since he proposed it to replace the homonymic *Spirorbis* Swainson (1840: 337).[1] Of course, *S. vulgaris* Swainson (loc. cit.) which was the only species included by the last, was vested solely by citation of the figures Draparnaud (1805: 45) gave for his *Planorbis vortex,* var. beta, and these apparently represent *Gyraulus (Omalodiscus) leucostoma* (Millet). The last also has been considered either a distinct species, or a form of *G. spirorbis* (Linné). Unfortunately, Pilsbry (1934: 63), followed again by F. C. Baker (1945: 51) and many others, accepted Kennard & Woodward's later selection, 1924, Proc. Malac. Soc. London *16:* 11, of *P. marginatus,* which also was included by Benson, and thus considered *Omalodiscus* a synonym of *Planorbis.*

These notes were made during an arrangement of fresh-water Pulmonata in the previously unlabeled collection of the Academy of Natural Sciences of Philadelphia. In this, *Omalodiscus* is used as a subgenus of *Gyraulus* in the Planorbidae. *Anisus* is listed in the synonymy of both *Physa* (Physidae) and *Planorbis,* which is where Studer autocratically proposed it. The abbreviated references have been checked with the originals, but, since they are listed handily by Zilch, 1960, Handb. Paläozool. *6* (4) : 731-795, why repeat them here?—H. Burrington Baker.

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[1] Benson stated: "This name having long been pre-occupied by a genus of *Annelides,* Swainson's subgenus requires a change of designation."

Planorbarius Duméril, 1806, Zoologie Analytique: 164, evidently is an invalid emendation of *Planorbis,* and automatically takes the same type. He apparently considered his "planorbarius" as a Latin synonym of his French "planorbiers." On the same page, he also emended *Trochus, Sigaretus, Turbo, Valvata, Natica* and other names in a similar manner, also without mention of their original authors. The fact that Froriep (1806: 165) added "helix cornea" as an example ("beyspiel" of preface: xx) in his German translation has no effect on this. The earliest valid name for the genus for which *Planorbarius* has been used is *Coretus* "Adans., 1757" Gray (1847b: 180), type by original designation *C. corneus* [Linné]. Incidentally, the prior name for its subfamily is Coretinae Gray (1847b, loc. cit., as Coretina).—H. B. B.

Melampinae:—The older writers used Melampidae (Stimpson, 1851) or Melampinae (H. & A. Adams, 1855) but Crosse & Fischer (1880) changed this to Melampodinae. Perhaps *Melampus* did come originally from 2 Greek words meaning black and foot but, according to Ainsworth's (1830) "Latin Dictionary," the Romans used at least the physician's name, exactly as Montfort (1810) spelled it, with the genitive melampi. For this reason, Melampinae seems to be the better form.—H. B. B.

Paludomidae (Pleuroceridae).—Of the 5 familial names prior to Pleuroceridae Fischer, 1885, all apparently are "nomina oblita" except Paludominae Gill, 1871, which was used by Pilsbry as late as 1956. In a rearrangement of the A.N.S.P. collection, which mainly follows Goodrich's careful studies in its systematic outlines, *Pleurocera* Rafinesque (1818) is used in its usual sense, in the hope that the I. C. Z. N. finally will adopt the petition to preserve it with the type *P. acuta* Rafinesque, 1831 (or Blainville, 1824?). As Pilsbry pointed out in 1917, *Ceriphasia* Swainson, 1840, is the legal name of the group. On the other hand, even Rafinesque would not have squeezed his *P. acuta* into his definition of the "genus *Oxytrema,*" 1819, which makes Blainville's (1824, under "*Pleurocerus*") and Morrison's (1954) addition of that species simply impossible. One must draw the line somewhere, even in nomenclature. However, since *Elimia* H. & A.

Adams, 1854, type (Pilsbry & Rhoads, 1896) *E. acutocarinata* (Lea), would not become obsolete for several years, it is employed instead of the subsequent, but more usual *Goniobasis* Lea, 1862, which both Goodrich and Morrison suggested may belong in *Gyrotoma* Shuttleworth, 1845. To be on the safe side, although both of these synonyms apparently are "nomina oblita" according to the latest "code," *Elimia laqueata* (Say) now is selected the type of *Melasma* H. & A. Adams, 1854, and *E. silicula* (Gould) the type of *Juga* H. & A. Adams, 1854. Since there have been so many guesses about the identity of *Ellipstoma* Raf. (1818), *Lithasia* Haldeman, 1840, is used for the group, of which *Pleurocera* evidently is the legal name. *Leptoxis* Rafinesque, 1818, is employed instead of the much-emended *Anculosa* Say (1821).—H. Burrington Baker.

Directory of conchologists of the world ($2.65 postpaid). —It has been our custom to revise the directory every two years. The 1962 edition is available and lists some 3,200 names and addresses. This list is composed of persons or institutions interested in the study or collection of mollusks, and we wish to make it as complete as possible.

When known the names will be followed by numbers indicating interests from the following key or other specialties.

1. World Wide Shells.
2. Land Shells.
3. Fresh Water Shells.
4. Fossil Shells.
5. Exchange Shells

We plan to issue a revised edition early in 1964, and will appreciate having our attention called to both errors and additions as we are now starting to assemble the data for the 1964 directory. There is no obligation to purchase a copy.

It is our custom to mail the first issues to those who have ordered and paid. They will have some advantage in seeing the names of the new collectors in the 1964 Directory of Conchologists of the World.—John Q. Burch, 4206 Halldale Avenue, Los Angeles 62, California.

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THE NAUTILUS

Vol. 77 October, 1963 No. 2

STUDY OF A POPULATION OF SPHAERIID CLAMS IN A TEMPORARY POND[1]

By GRACE JEAN THOMAS
University of Georgia

The following study of the composition of a population of *Sphaerium (Musculium) partumeium* took place over a two-year period.

The pond which contains the clams is located near Ann Arbor, Michigan[2]. It was the site of a study by Kenk (1949) in which he compared its fauna with that of other ponds. In addition, DeWitt (1954) used it as a source of material for his study of the life history of *Physa gyrina.* The occurrence in the pond of a very large population of a single bivalve made it a particularly favorable spot for a population analysis.

Ecology of the habitat. The pond, which is located in an open field, has a bottom covered with a layer of rich organic material and a maximum water depth of about 65 centimeters (2 feet, 1½ inches). The number of months that water stands in this habitat varies from year to year. Most commonly the pond dries up in July, and remains that way until October or November when it is refilled by autumn rains. In years of reduced rainfall, however, it remains dry over the winter months and is not refilled until March, or even later.

The pond is bordered on two sides by wide bands of *Typha.* The bottom shows small patches of bare mud, but most of it is covered with *Alisma* and *Zizania aquatica.* The *Alisma* is dominant when the water level is low, and *Zizania* is luxuriant when the pond is full, long after the emergent vegetation has died down.

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1 This study was a portion of research done in partial fulfillment of the requirements for the degree of Doctor of Philosophy at the University of Michigan. The author wishes to express her thanks to Dr. Frank E. Eggleton for his interest and encouragement, and to Rev. H. B. Herrington for the identification of the clams.

2 On the west of U.S. highway 23 just north of its intersection with U.S. highway 112 (T3S/R6E/S23).

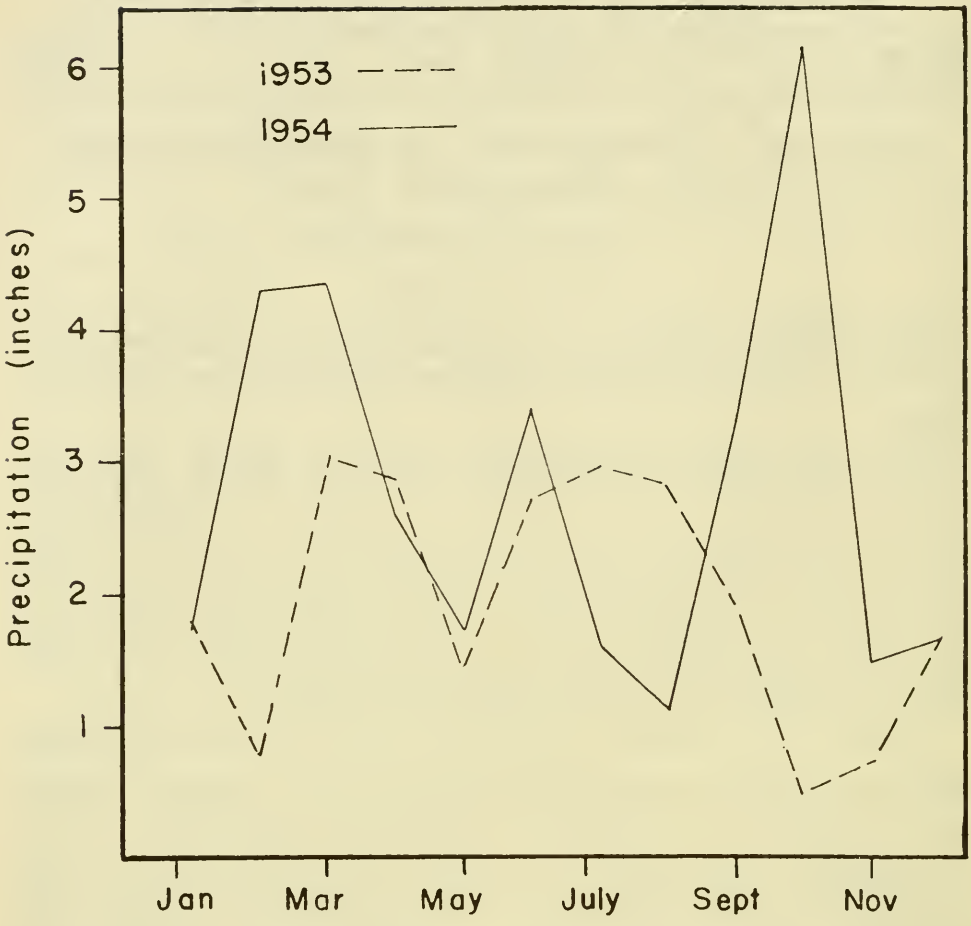

Figure 1. Total monthly rainfall for the years 1953 and 1954.

The fauna includes micro-Crustacea, hydracarina, leeches, oligochaetes, nematodes, turbellarians, many of them in very large numbers. The mollusks are represented by *Sphaerium partumeium* and 5 species of snails, *Gyraulus parvus, Helisoma trivolvis, Lymnaea palustris, Physa gyrina,* and *Planorbula armigera.* Of these, the clams, *Lymnaea palustris* and *Physa gyrina* are very common.

Methods. Samples were taken monthly from January, 1953, until March, 1954. At that time a program of weekly sampling was instituted, and continued until July 23, 1954. The study was to be ended then, but in October, 1954, heavy rains filled the pond and made an extension of the sampling desirable. Collections were taken until March of 1955.

In sampling, an attempt was made to secure enough material

TABLE 1

COMPOSITION OF MONTHLY SAMPLES

Month	Total Number of Clams	Size Classes (Length in mm in Parentheses)								
		1 (1-2)	2 (2-3)	3 (3-4)	4 (4-5)	5 (5-6)	6 (6-7)	7 (7-8)	8 (8-9)	9 (9-10)
1/53	164	38	126	0	0	0	0	0	0	0
2/53	44	29	15	0	0	0	0	0	0	0
3/53	316	138	178	0	0	0	0	0	0	0
4/53	297	15	153	127	2	0	0	0	0	0
5/53	184	1	8	74	97	4	0	0	0	0
6/53	167	10	0	14	105	38	0	0	0	0
7/53	83	49	0	7	18	9	0	0	0	0
8/53	70	60	0	1	7	2	0	0	0	0
9/53	74	67	6	1	0	0	0	0	0	0
10/53	81	60	21	0	0	0	0	0	0	0
11/53	79	56	20	3	0	0	0	0	0	0
12/53	75	61	4	6	4	0	0	0	0	0
1/54	46	36	10	0	0	0	0	0	0	0
2/54	23	11	12	0	0	0	0	0	0	0
3/54	238	165	73	0	0	0	0	0	0	0
4/54	554	16	149	236	141	12	0	0	0	0
5/54	520	0	1	20	147	208	132	10	0	0
6/54	1172	404	1	0	4	82	305	286	85	5
7/54	643	376	52	4	0	4	63	116	27	5
10/54	301	217	84	0	0	0	0	0	0	0
11/54	154	2	48	78	26	0	0	0	0	0
1/55	192	6	39	81	66	0	0	0	0	0
2/55	85	0	22	48	15	0	0	0	0	0
3/55	296	0	21	95	155	24	1	0	0	0

each time to furnish at least 75 to 100 clams. However, during a few winter months, this was impossible. The samples were all carried into the laboratory for careful sorting, so that the young would not be missed. Once the specimens were measured, the sample was broken down into size classes, and the percent of individuals falling within the limits of each size class calculated. The monthly totals for the period from March 13, 1954, to July 23, 1954, represent the lumping of weekly samples. The measurement used in setting up the size classes was shell length. Since none of the shells measured less than one mm., or more than 10 mm., 9 size classes were set up as shown in table 1.

Measurements of total monthly rainfall for the years 1953 and 1954 (secured from the United States Weather Bureau at Willow Run) were plotted in figure 1.

Results. The total number of clams taken each month, and the numbers falling in each size class are given in table 1. The number of individuals in a collection varied from 23 in one February sample to over 1000 in a month during which weekly collections were taken. The small numbers taken from frozen ground in January and February, however, show a size class

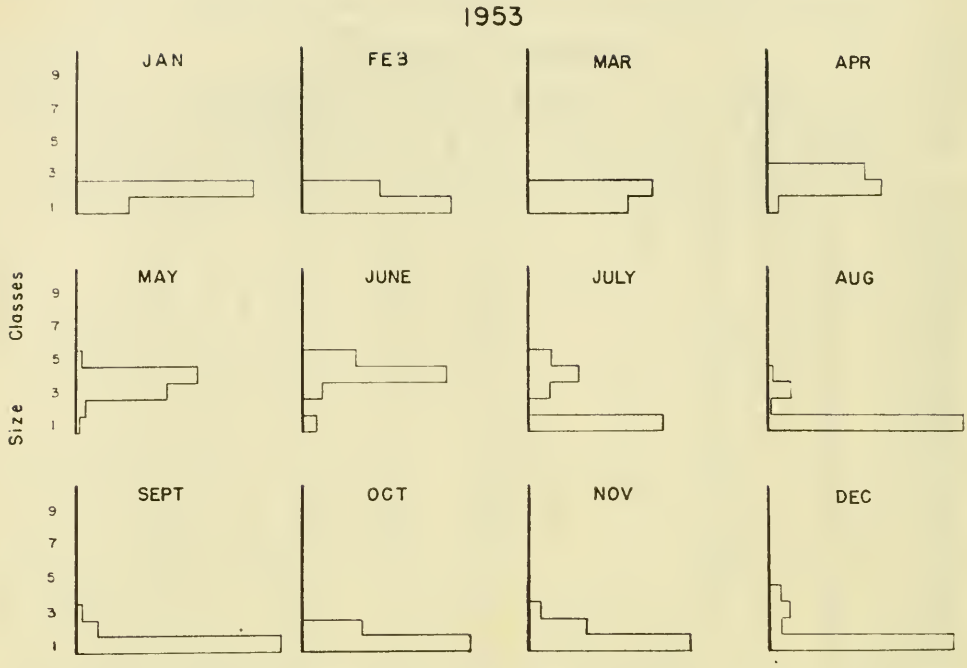

Figure 2. Histogram showing the monthly composition of the population during 1953.

distribution which is quite consistent with the months preceeding and succeeding them.

The numbers of individuals in size classes were converted to percentages which are plotted as histograms in figures 2 and 3. In January, February and March of 1953, only the first two size groups made up the population. The pond had been dry all winter, and finally filled in March when 3 inches of rain fell. The April, May, and June data showed that the clams were growing, and in addition, in June, the first young were produced. Meanwhile the water level was being lowered gradually by increasing evaporation and little precipitation, and by June 18 the standing water had disappeared. Rooted vegetation (chiefly *Alisma*) grew up rapidly and prevented the soil from parching and cracking. Many dead shells of adult clams were found in July and August. During the remainder of the year, when there was no standing water, the population once more consisted mostly of the smallest size class. These clams were living buried in the mud.

In 1954 heavy rains in February caused the pond to fill by March. The clams grew rapidly during April, May, June, and

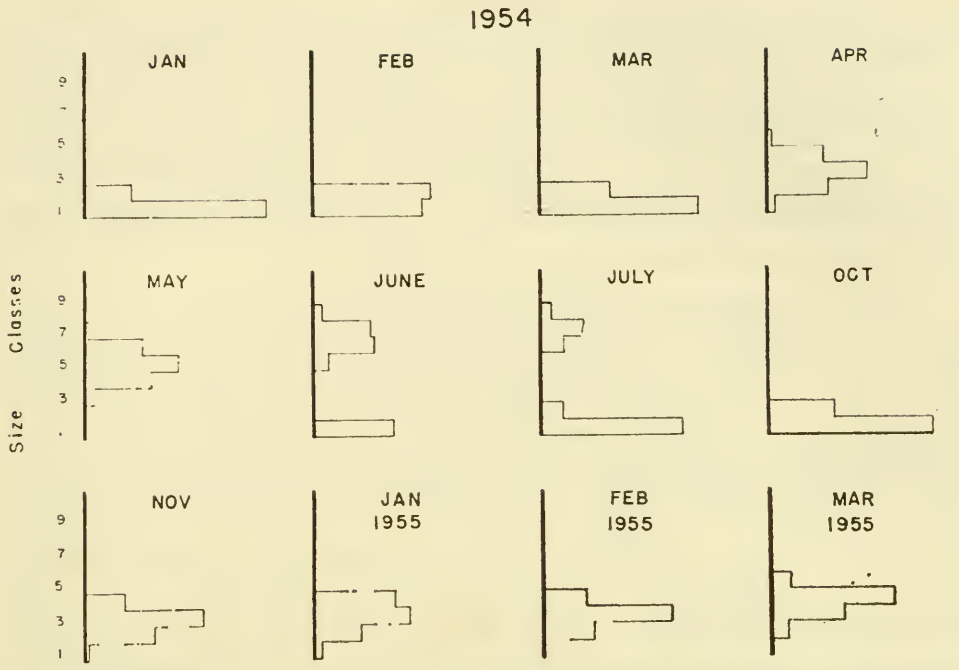

Figure 3. Histogram showing the monthly composition of the population during portions of 1954 and 1955.

July, and attained a greater size than in 1953. The growing period was one month longer, for the pond was not dry until the third week in July. Note also that the young which began to appear in June also showed growth.

No collections or observations were made during August or September, but when very heavy autumn rains filled the pond in October, a sample was taken, and another in November. In the latter collection was a large number of clams of classes 3 and 4. By December ice covered the pond and, although no clams were taken then, collections were made under the ice in January and February of 1955. By early March the ice cover was gone, and the collection taken then indicated that the animals had already resumed growth.

Discussion. The data indicate that the life cycle of *Sphaerium (Musculium) partumeium* is 12 or 13 months in length, but that it may be shortened by the early loss of standing water from a temporary pond. The definitive size of the animals is also affected by rainfall. This fact was shown clearly by clams which presumably had emerged in early summer of 1952, showed no appreciable growth until the following April, and died off in

the following June and July, none of them having attained a length of more than 6 mm. On the other hand, clams produced in June or July of 1953, because of the early filling of the pond in the following March, showed much more growth by April. In addition they lived at least into July at which time a few of them measured between 9 and 10 mm. There was no indication that growth occurred under ice cover.

Another interesting point brought out by the data is the fact that the population is primarily carried over the dry period by the young. Very few sub-adults (3-5 mm.) were able to survive. Aestivation is a phenomenon which has been reported in a number of species of clams. Van der Schalie (1939) reported it in 4 species of unionids, Vielhauer (1943) in *Musculium lacustre,* Boycott (1936) in *Pisidium personatum* and *Pisidium cinereum. Sphaerium occidentale* occurs regularly in temporary woods pools. In some of these cases, the life cycle is two or more years long, (Herrington, 1943, 1947) and so the sub-adults regularly aestivate. In these cases, however, the animals may be able to burrow into deep mud, or as in the case of a woodland pool, the conditions are less variable than in an exposed one.

The temporary field pond studied here is a severe habitat. The water temperatures vary from 3° Centigrade under ice to 24° C., and on the surface of the exposed mud, 28° C. or higher. Kenk (1949) reported pH values varying from 5.8 to 7.7, and dissolved oxygen fluctuation of 10 ppm. When ice covers the pond, hydrogen sulfide, formed in the decomposition of bottom material, is produced in quantities sufficient to produce a noticeable odor. *Sphaerium partumeium* appears to be tolerant of such physical and chemical conditions.

Sphaerium is successful in this habitat primarily because of this tolerance, its ability to grow rapidly under favorable conditions, and its precocious production of young (Thomas, 1960). The rapid growth is made possible by a combination of favorable factors. This study has emphasized the importance of water which enables the animal to make use of a filter feeding apparatus, makes possible the growth of food organisms, serves as a solvent for the various nutrients, and has a moderating effect on the temperatures to which the habitat is subjected.

Summary

1. A population of *Sphaerium (Musculium) partumeum* in a temporary pond was sampled monthly for over two years.

2. The life span of the clams is 12-13 months, but it may be shortened by drying up of the habitat.

3. The clam population is maintained over the winter primarily by the young individuals.

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SOME GONIOBASES IN WESTERN UNITED STATES

By ERNEST J. ROSCOE
Raymond Foundation, Chicago Natural History Museum

The small disjunct group of goniobases, which occur in the western part of North America, has been the subject of a number of reviews and revisions since the middle of the last century (Tryon, 1865; Pilsbry, 1899; Henderson, 1935; Goodrich, 1942, 1944). On the basis of shell sculpture, two broad categories have been recognized: (1) a group in which there is some kind of conspicuous longitudinal or vertical sculpture (ribs, plicae, etc.) on the whole or some portion of the shell, and (2) a group in which such sculpture is either vestigial or entirely lacking. Judgment is here reserved as to whether this grouping represents natural biological units. The present paper is limited to a discussion of certain species in the latter, or so-called "smooth" category.

In 1847, Gould described *Goniobasis bulbosa* from an undesignated locality on the Columbia River. In 1860, Lea described *G. newberryi* from the "upper Des Chutes River, Oregon Territory." Following Tryon (1865), most authors up to Pilsbry

(1899) have recognized *bulbosa* and *newberryi* as similar but distinct species, the chief diagnostic criterion being the presence of color bands in *newberryi*.

Revising the goniobases of Washington and Oregon, Pilsbry (op. cit.) arrayed the "smooth" forms known from the region as follows:

G. bulbosa (Gould, 1847).
Syn: *G. newberryi* Lea, 1860.
G. nigrina (Lea, 1856).
Syn: *G. draytonii* Lea, 1862.
G. circumlineata Tryon, 1865.
G. californica (Clessin, 1882).

Pilsbry hesitated to synonomize *nigrina* under *bulbosa* although he thought such relationship "very likely." He recognized *nigrina* as characteristic of the Sacramento drainage, *bulbosa* as characteristic of the Columbia drainage.

An extensive study of western goniobases in the collections at Stanford University and the University of Colorado led Henderson (1936:272) to conclude that:

"From the description and figures, together with photographs of specimens in the National Museum, I seriously doubt whether specimens suspected of being *bulbosa* could be identified even by comparison with the types. Various lots labelled *bulbosa* in the Hemphill and other collections are not in any way related to it. The specimens we obtained at the mouth of the Deschutes River are *plicifera,* and those we obtained at Maupin, some distance up that river, represent a recently described form, *G. hemphilli maupinensis* Henderson. *A good series from the upper parts of the Deschutes is highly desirable, in order to ascertain just what* newberryi *is.*" (Italics mine, E. J. R.)

Through the courtesy of Drs. L. S. Cressman and David L. Cole, Department of Anthropology, University of Oregon, I have recently had the opportunity to study goniobases from an archaeological site in the middle Deschutes River drainage which I believe has a bearing on the *bulbosa-newberryi* problem. This material comprised 25 specimens, some consisting only of fragments of body whorls, from two rock-shelter middens, designated Round Butte sites nos. 1 and 2, located near the confluence of the Metiolus and Deschutes Rivers, Jefferson Co., Oregon (for map see Stearns, 1931). The goniobases occurred with almost 1000 specimens of the freshwater mussel, *Margaritifera margari-*

tifera (L.), from the surface of the middens to a depth of 180 centimeters. A maximum of 4 goniobases occurred in any 20 cm depth interval.

Some of the Round Butte midden specimens are unbanded and appear to fit the description and figures of Gould's *bulbosa* as given by Tryon (1865, pl. 24, fig. 17). A single fragment of the body whorl of one specimen (Pl. 4, fig. 5; l. 11.3 mm., d. about 5.6 mm.; aper. l. 6.0 mm., aper. d. about 4 mm. [outer edge broken]; CNHM. no. 111879) bears the 3 color bands typical of Lea's *newberryi* (see Tryon, 1865, pl. 24, fig. 16). The remaining specimens, of typical *bulbosa* shape, show one or more broad (coalesced?) bands of color on the body whorl, quite different from those described for *newberryi* (Pl. 4, fig. 6; l. 11.9 mm., d. 6.0 mm., aper. l. 5.4 mm., aper. d. 3.7 mm.; CHNM. 111878).

The significance of the Round Butte material is that it seemingly represents a population transitional between the two nominal species *bulbosa* and *newberryi*. Moreover, it is the first *Goniobasis* material to be recorded from the Deschutes River above Maupin, and the first of the *bulbosa* complex to be recorded from that stream above its mouth. It seems to bear out Henderson's prediction (1936:272) that material from the upper part of the Deschutes River would resolve the *bulbosa-newberryi* problem.

While examining the Round Butte midden specimens, opportunity was also taken to compare them with the few known Great Basin forms. The first report of goniobases from the Basin proper was made by Goodrich (1935). He remarked that his specimens had been compared with the types of *G. newberryi* in the U.S. National Museum and found ". . . no difference between the two forms except in the unimportant matter of color bands." Subsequently Goodrich (1944) described his Great Basin material under the names *G. laurae* and *G. interioris,* from two localities in Nevada.

Comparison with paratypes of Goodrich's species, loaned through the courtesy of Dr. Henry van der Schalie, Museum of Zoology, University of Michigan, shows that *G. laurae* (Pl. 4, fig. 7; l. 11.6 mm., d. 6.1 mm.; aper. l. 5.5. mm., aper. d. 3.4 mm.; UMMZ. 160004) tends to be larger than the Round Butte

midden goniobases, but that comparably sized specimens from the two localities are very similar in appearance (cf. figs. 2, 3). *G. laurae* is generally more elongate and not as bulbous as the Round Butte material, in this regard *laurae* resembling *draytonii* and *nigrina* more closely than *bulbosa*. Although the original description of *laurae* stated that no varices exist, one is clearly visible on the left side in the accompanying figure of a paratype (fig. 3). In the Round Butte specimens, the varices are moderately conspicuous or absent. There are no signs of sculpture on either *laurae* or the Round Butte specimens. *G. laurae* is of a uniform color, while the Round Butte material exhibits considerable variation in this regard.

That both *laurae* and the Round Butte specimens are distinct from *interioris* is evident in the accompanying photographs. *G. interioris* does bear a similarity to *draytonii,* which is more noticeable in the drawings of the type of *interioris* (Goodrich, 1944, fig. 2) than in the accompanying photograph (Pl. 4, fig. 8; l. 20. mm., d. 7.5 mm., aper. l. 6.4 mm., aper. d. 5.3 mm.; UMMZ. 160006) of a paratype. *G. interioris* is longer, more bulbous, and with a rounder aperture than typical *draytonii*.

Finally, a word regarding an interesting facet of the ecology of the Great Basin goniobases. *G. laurae* was found in seepage from springs in both Nevada and California, and *G. interioris* was collected from an outlet of artesian wells in Nevada (Goodrich, 1944). At the time of excavation, the Round Butte site was quite damp from spring seepage (Cole, personal communication, Feb. 1, 1962). No living goniobases were found in this seepage, but the possibility that they may have lived in this niche in the past cannot be ruled out entirely. At the moment, however, I am inclined to the view that the Round Butte goniobases represent individuals accidentally carried to the site attached to the fresh-water mussels which constitute the bulk of the site material.

The photos of figs. 5 to 8 were made by John Bayalis and Homer V. Hondren, C. N. H. M.

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MOLLUSCAN FAUNA OF SOME ALKALINE LAKES AND SLOUGHS IN SOUTHERN CENTRAL NORTH DAKOTA

By SAMUEL J. TUTHILL[1] and WILSON M. LAIRD[2]

Thirteen bodies of water in central North Dakota have been sampled for their molluscan fauna and some aspects of their limnology. The presence of molluscan communities in bodies of water having total alkalinity of as much as 1145 ppm. and total dissolved solids of as much as 5210 ppm. is noteworthy.

The living molluscan fauna of North Dakota has been poorly studied in the past, that of the Devils Lake area being the only part to have received systematic treatment (Winslow, 1921). A study of the molluscan faunas of various Pleistocene age sediments in central North Dakota, undertaken by the senior author, necessitated a better knowledge of the living fauna of the area in order to interpret adequately the fossil faunas. The study reported here is the first part of a larger reconnaissance investigation designed to establish the nature of the Pleistocene and Recent molluscan fauna of the glaciated portion of the State.

We feel that the presence of successful communities of mollusks in highly alkaline environments, as reported here, is of general interest to ecologists and paleo-ecologists. We do not, on the basis of such cursory sampling, suggest that the faunas listed are complete, but the ecologic data does at least apply to those species we do report. Further work may add other species to the faunal lists.

During the summer of 1961, the senior author spent 6 weeks in McIntosh County studying the Pleistocene deposits and their associated molluscan faunas for the North Dakota Geological

1 Graduate Student, NDEA Fellow University of North Dakota.
2 Chairman, Department of Geology, University of North Dakota and State Geologist, North Dakota Geological Survey.

Survey. Note was taken of the Recent and living fauna of the sloughs and lakes of the area and collections were made. In October of 1962, we spent three days conducting an intensive sampling program of the water bodies reported here. Water, bottom sediments, and the mollusks were collected. Partial analyses of the water and bottom sediments were conducted during the following week and the fauna was identified and curated in the Geology Department collection at the University of North Dakota.

Physiographic setting. The Missouri Coteau district (Fenne-

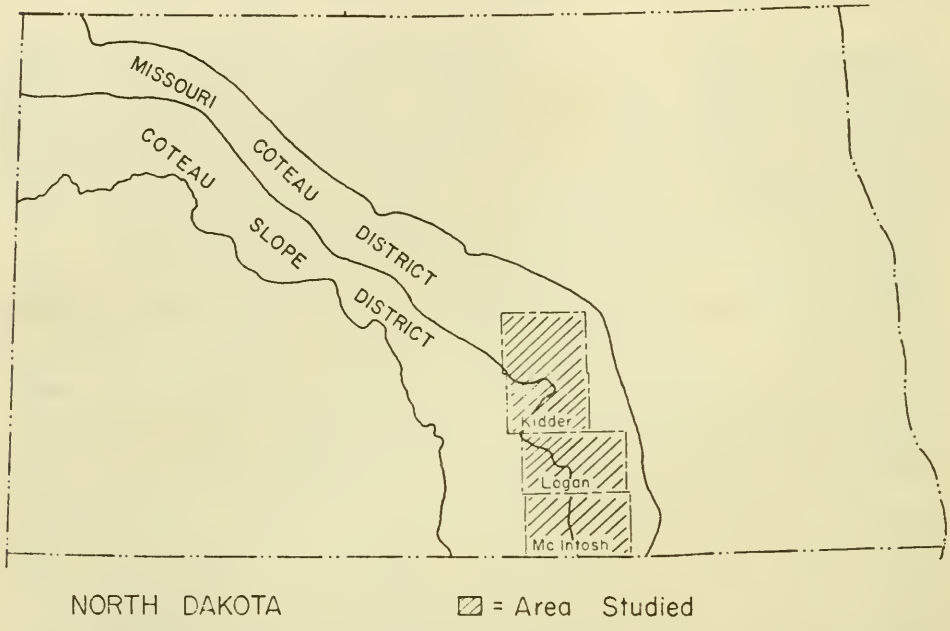

Fig. 1a. Sketch map of North Dakota showing area of this study (cross-hatched) and approximate distribution of the Missouri Coteau and Coteau Slope district.

man, 1931, p. 75) in North Dakota, extends from Dickey and McIntosh Counties in the southern part of the state to Divide County in the north and extends as much as 50 miles on an east-west axis (see fig. 1). It is characteristically an area of non-integrated drainage, low hills and depressions without orientation. The entire Coteau is surfaced by upper Wisconsin drift and its topography is the result of deposition from stagnant glacier ice. Clayton (1962, in press) has restricted the Missouri Coteau of Fenneman to the area of non-integrated drainage, creating the Coteau Slope district for the area between the Missouri River

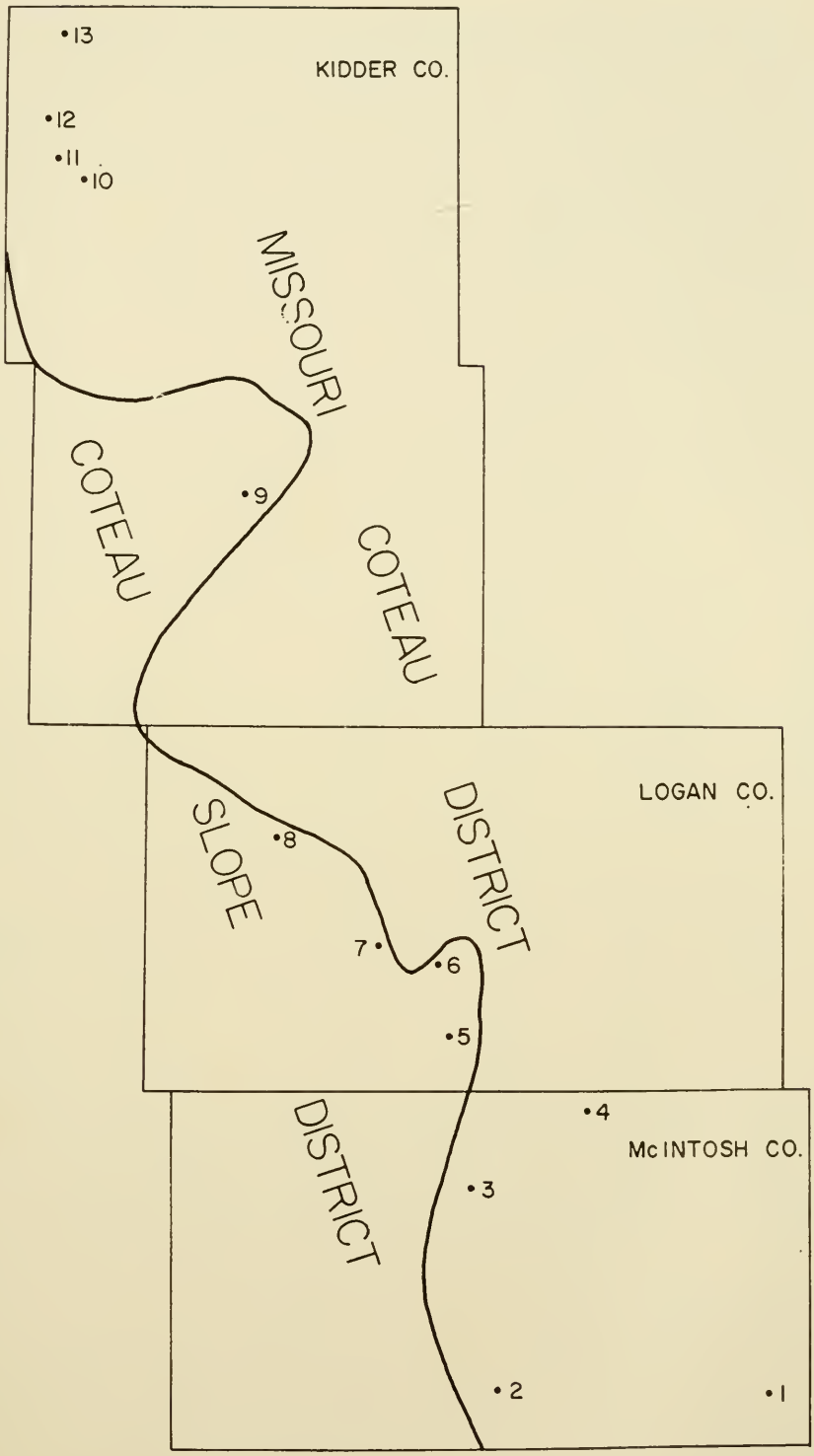

Fig. 1b. Sketch map of the area of this study showing the approximate locations of the various sites (see text).

and the Coteau. The Coteau Slope district is characterized by an integrated drainage system and is presumably of greater geomorphic age. Most of the drainage is integrated with the Missouri River but some is internal only. Several of the bodies of water reported here are in the Coteau Slope district. Possibly the water bodies in the Coteau Slope district are of greater age than those in the Missouri Coteau district. Molluscan population in the bodies of water in the Coteau Slope district might therefore be older in lineage than those in water bodies in the Missouri Coteau district.

Geologic setting. The lakes and sloughs sampled all have their basins in sediments of Wisconsin Age drift. Those in the Coteau Slope district are in drifts which are possibly of middle or early Wisconsin age while those on the Coteau are in sediments of later Wisconsin age. Radio carbon dates from the Coteau sediments indicate that they are approximately 8000 to 11,000 years old.

The sediments of the Missouri Coteau district are till and outwash. The topography developed on these two sediment types varies within a maximum local relief of approximately 600 feet. The Burnstad Drift of Clayton (1962, in press) is the stratigraphic unit which makes up the Missouri Coteau. His Zealand Drift and Rau's Long Lake Drift (1962, p. 23) are the units which surface the eastern portions of the Coteau Slope. The Pierre Shale Formation (Upper Cret.) underlies the thick (possibly 600 feet in places) drift cover.

In the Coteau Slope district, the drift is much thinner and bedrock exposures, although not common, are more numerous than in the Missouri Coteau district. In its eastern half, the part with which we are here concerned, the underlying bedrock is primarily Foxhills Formation with some Pierre Formation (Upper Cret.). Dissection by streams flowing west and southwest to the Missouri River dominates the topography.

Climate. The climate of the area has been described by Thornthwaite (1948, pl. 1) as dry subhumid first (cool) mesothermal. The U.S. Department of Agriculture has published a summary of the thermal and precipitational records of North Dakota. A combined frequency polygon for precipitation in the area of this study can be seen in Fig. 2; other data is given in

Table 1. The mean growing season for the 5 communities in this area, at which records have been kept, is 113 days. The average date for first frost is Sept. 15. We assume that the period of molluscan activity will approximate the growing season and that they will be in a dormant state during the balance of the year. The pattern of distribution of precipitation during this 113-day period is, therefore, the most significant portion of the polygon. The rains of May and June create many ephemeral aquatic environments in the undrained depressions of the Missouri Coteau and in the intermittent streams of the Coteau Slope district which do not survive the periods of decreasing precipitation in July, August and the first half of September. Evaporation exceeds precipitation (moisture deficiency index 0 to -20).

Table 1a:—Average precipitation in the area of this study.

Community of Record	Record Period	Mean of Means (in. ppt.)	Median of Means	Mean Annual
Ashley, McIntosh Co.	36 yrs.	1.51/mo.	1.27 in.	18.08 in.
Wishek, McIntosh Co.	18	1.31	1.12	15.74
Napoleon, Logan Co.	40	1.41	1.21	16.95
Steele, Kidder Co.	40	1.46	1.11	17.51
Pettibone, Kidder Co.	30	1.37	1.12	16.39

Table 1b:—Average January and July temperature in the area of this study.

Community of Record	Record Period	Jan. Mean (°C)	July Mean (°C)	Max. (°C)	Min. (°C)
Ashley, McIntosh Co.	37 yrs.	-13½	20½	45½	-43
Wishek, McIntosh Co.	18	-13	21	49	-42
Napoleon, Logan Co.	40	-14½	20½	48	-45
Steele. Kidder Co.	36	-14	21½	50	-56
Pettibone, Kidder Co.	26	-15½	20½	48	-48

Note: It should be pointed out that temperature extremes below the freezing point of water do not usually effect aquatic mollusks. The shallow nature of the water bodies in the area of this study make freeze-out a distinct possibility. Extermination by this means is unlikely as mollusks would probably survive in either the egg or adult form in mud at the bottom. A combination of a season of extreme low water and a cold winter might have a profound impact on the succes of a molluscan population.

This deficiency is an important factor in the chemical aspect of the environment and has not been experimentally assessed.

Thermal data are given in the form of January and July averages and maximum and minimum values for the five communities. A summary of these data can be seen in table 1b. The values have been converted to the metric system for the sake of internal consistency. The 106 degree range at Steele is striking, but that

Table 2. Summary of Ecologic Data

LOCATION	DATE SAMPLED Oct. 1962	pH	TEMP. °C	ALKALINITY (ppm) TOTAL	CO_3	HCO_3	CO_2 (ppm) FREE	TOTAL
(1)	15	7.70	13.0	429	0	429	0	380
(2)	16	8.75	9.4	204	40	164	0	180
(3)	16	7.50	10.0	304	24	280	0	270
(4)	7	no water data						
(5)	16	6.23	10.6	96	0	96	110	80
(6)	16	8.20	10.6	471	0	471	0	410
(7)	16	7.97	10.0	170	38	132	0	150
(8)	16	no water data						
(9)	17	8.50	9.6	853	214	639	0	740
(10)	17	8.20	——	990	32	958	0	870
(11)	17	no water data						
(12)	17	8.18	——	1145	12	1133	0	1000
(13)	17	8.23	——	345	0	345	3.6	300

portion below 0 degrees may have little ecologic impact on dormant mollusks. If extremely low precipitation over a period were to combine with a subsequent period of extremely low temperatures, freeze-out of the bottom sediments could certainly occur. Probably this situation would cause local extermination of molluscan populations.

Methods. Water: A one-quart water sample was taken from a foot below the surface. As all the water bodies were thermally

TOTAL SOLIDS (ppm)	AREA (acres)	DEPTH (feet)	BOTTOM SEDIMENTS % SOL. HCl	% LOSS IGNIT.	GRAIN SIZE
15780	40	2.6	51.4	24.7	gel
5000	480	5.8	3.1	4.5	fine sand
2600	1120	7.0	31.7	26.4	gel
					clay size mud
180	$< \frac{1}{4}$	10.0	----	----	med.-cr. sand
830	160	<6.0	----	----	clay size mud
4730	1600	5.1	31.6	25.8	gel
					clay sized mud
5210	850	8.3	31.8	26.4	gel
3150	1600				fine sand
2280	750				med. sand
470	340				med. sand

unstratified, no purpose would have been served by a more complicated sampling technique. The presence or absence of dissolved CO_2 was established by the method of Theroux and others (1943, p. 9). A model 9600 Beckman pH meter was used to determine pH values. The concentrations of various ions here reported were established by the techniques described in "Standard Methods for the Examination of Water and Wastewaters," 11th Edition, 1960.

Table 3

Aquatic Mollusks	1	2	3	4	5	6	7	8	9	10	11	12	13
GYRAULUS PARVUS				X		X	X	X	X	X	X	X	X
LYMNAEA PALUSTRIS		X	X	X	X			X		X		X	X
PHYSA sp.		X		X	X	X	X	X				X	
GYRAULUS sp.		X	X				X	X		X		X	
HELISOMA TRIVOLVIS		X		X	X		X			X			X
PROMENETUS EXACUOUS							X	X	X	X			
LYMNAEA HUMILIS	?					X	X	X		X	X		
ARMIGER CRISTA				X			X	X		X			
PISIDIUM sp.			X					X		X		X	
LYMNAEA STAGNALIS				X				X					X
APLEXA HYPNORUM				X			X	X					
VALVATA TRICARINATA							X	X					
AMNICOLA LIMOSA							X						
HELISOMA ANCEPS							X						
SPHAERIUM sp.		X											

Note:-The mollusks are arranged in the order of the frequency of their occurrence

Temperature: A Whitney Marine thermometer permitting accuracy of 0.1° C was used to determine temperature. The water temperature was taken throughout the maximum depth of the water and the sediment temperature was also taken.

Bottom Sediments: An Eckman dredge was used to obtain samples of the bottom sediments. These were examined for: grain size by wet sieving and hydrometer analysis; carbonate by acid digestion; and organic content by calculation from data obtained by ignition. The contained molluscan fauna were removed from each sample during the grain size analysis.

Depth: Direct sounding with a measured cable was the method used for determining depths. In no case was the depth sufficient to necessitate correction for drift. Depth values are not necessarily maximum depth of the bodies of water, but merely the maximum values recorded during our sampling.

Fauna: Shells found in the sediments were removed from the bottom samples. A dredge net for sampling the aquatic vegetation and the surface of the bottom was also used. Where shells were found concentrated at the strand line, they were collected by hand and a grab sample was taken and examined under magnification of 9 to 45 X. Shells were used as the basis for identification, but living representatives were present in the sample from each of the water bodies.

(To be continued)

REVISION OF A WEST AFRICAN HALIOTID

By ROBERT R. TALMADGE
Field Associate, Dept. of Invertebrate Zoology, Calif. Acad. Sci., Willow Creek

For many years the malacological world has known that some species of the sea ear or abalone, genus *Haliotis* were to be found along portions of the coasts of West Africa. However, when the literature is scrutinized, apparently the identification is somewhat amiguous, and in many cases the generalized distribution needs verification. Comparative specimen material, at least in America, is not too plentiful.

There are sets of shells collected in the Canary Islands scattered among major museum and private collections in this country. Talmadge (1958) covered the systematics of the species found in this island group; the work being based upon a comparison of not only the shells, but anatomical features as well. The variable insular species was identified as *Haliotis (Sanhaliotis) coccinea* Reeve. Both *H. zealandica* and *H. janus* Reeve, are classed as synonyms after selected specimens were compared with the original "Type" lots.

Specimen material from the mainland coasts of West Africa appears to be extremely limited. With the exception of my collection, the only material that I could locate was in the Academy of Natural Sciences of Philadelphia. This set, shells only, was used by Pilsbry (1890) when he wrote the last monographic work covering the family Haliotidae in Vol. 12, Manual of Conchology. Several of the specimens in this series were used for illustrations.

At the present time, the distribution of the haliotids along

the mainland coasts of west Africa is still a problem. Nickles (1950) verified Dunker's (1853) "Gulf of Guinea" locality, citing the "Gold Coast," now Ghana, on the north shore of the Gulf of Guinea. Pilsbry (1890) had eliminated the Cape Verde Islands, although references to this locality still persist, perhaps based upon Reeve (1846). Many of my letters of inquiry remain unanswered, some answers are contradictory, and since little comparative material is available to me from the general area, the distribution must remain, at least at this time, rather uncertain.

With the receipt of an excellent series of both shell and soft parts, through the courtesy of Dr. I. Marche-Machad, Dakar, Senegal, the taxon for that locale may be determined. Anatomical comparison indicates that this series is basically the same as the European-Mediterranean, *Haliotis tuberculata* Linné, and I would classify them as such. There is, however, a consistent and persistent shell variation, which is quite noticeable to persons familiar with the genus. In all the specimens examined, the recent Senegal as well as the Philadelphia series, I noted that the shells were not only smaller and comparatively thinner, but were also more elongate and deeper than the European-Mediterranean examples. These form a definite shell grouping. There are variations in coloration and sculpturing, but such polymorphic features are usual in most species of haliotids. The basic differences were noted in all age stages, which at least to me, is a strong indication of a local geographical race; similar soft parts with a distinct shell feature which separates a group from other populations of the same species, combined with a rather distinct geographical separation.

Rather than add a new name to the already overburdened systematics, I searched through the available literature in an effort to locate a name already applied to this population and which would be available. Pilsbry (1890) had identified the race as *Haliotis rosacea* Reeve, and Talmadge (1958) had followed this identification, but had used the trinomial, *H. tuberculata rosacea* Reeve, based upon a small set of shells which had an affinity towards the more northern race. Nickles (1950) had identified the species as *H. tuberculata* Linné, but did not separate the west African and the European-Mediterranean populations.

Dunker (1853) had also recognized the affinity of the Gulf of Guinea specimens with the more northern group, and had used the name *H. tuberculata* var. *striata* Linné. Philippi (1850) had identified the species as new under the name *H. descussata*. Variations in the specimens available match in close detail *H. marmorata, H. virginia, H. rosacea, H. striata,* and *H. pertusa,* all as identified and figured by Reeve, but not the same as the original authors.

Further search revealed that Wood (1828) figured and identified a haliotid as *Haliotis guinensis*. Wood's use of the name was traced to Gmelin (1791), who cited Schröter (1784) as his authority. It is interesting to speculate why both Reeve and Pilsbry missed this much earlier name. Perhaps it was confused with a name in Martini (1769), "Das Guineische, roth und Weis marmorite=exalba, rubro et fusco maculata, Guinaica," which is figured in Vol. 1, Pl. 16, fig. 149 of that non-binomial work. This is not a haliotid, but is probably a *Sinum*.

Gmelin (1791), Vol. 1. Pt. 6, page. 3689, gave the following: "H. guineensis, H. testa ovata subconvexa solida descussatim striata. Schrot. Einl. in Conch. 2, p. 388, T4 f. 18. Habitat rara ad Guineae littora." A more detailed description follows, indicating size, coloration, etc., which fits the specimens from Senegal. Through the courtesy of Drs. A. Myra Keen and Robert Robertson, microfilms of the title page, plate, and the two pages of Schröter's work were made available. Again there is no question in my mind that the Senegal material is the same as described in both Schröter and Gmelin. However, Schröter is non-binomial, so the name must be attributed to Gmelin. Because anatomical features indicate that this is only a geographical race of the European-Mediterranean species, and since Gmelin's use of the name is the earliest found in accepted binomial literature, I propose that the name be: *Haliotis (Sulculus) tuberculata guineensis* Gmelin (1791).

The opportunity to examine the collection at the Academy of Natural Sciences of Philadelphia was made possible by a Grant in Aid, No. P-2958, from the American Philosophical Society of Philadelphia. Appreciation is expressed to Dr. R. Tucker Abbott and the staff at the Academy of Natural Sciences of Philadelphia for making space available to me for comparative

work while I was at that institution.

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TYPE OF UNIO LUTEOLUS LAMARCK, 1819

By MARY J. WHEELER
Research Associate, Paleont. Research Inst., Ithaca, N. Y.

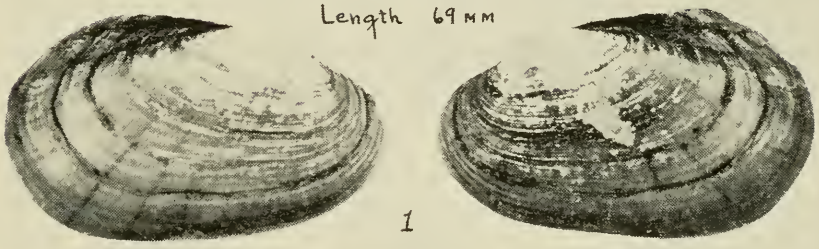
For many years there has existed a difference of opinion regarding the status of the name *Lampsilis luteola* (Lamarck), 1819, originally known as *Unio luteolus* Lam. Since 1922 this species generally has been known as *Lampsilis siliquoidea* (Barnes), 1823, originally *Unio siliquoideus* Barnes. I have made an attempt to clarify this situation.

In response to a request for photographs of the types of *Unio luteolus* Lam. and *Unio radiatus* Lam., 1819, the Laboratoire de Malacologie of the Muséum National d'Histoire Naturelle in Paris, France, where part of Lamarck's collection is deposited, kindly sent microfilms of the two types. These are herewith reproduced.

According to a personal communication (Oct. 3, 1962) from

TYPE of UNIO LUTEOLUS LAMARCK, 1819

Length 69 MM



1

Unio radiatus Lam. de la rivière Susquehana par
m^r Michaud. Cet individu d'abord celui qui a été décrit par
Lamarck sous le nom de Unio luteola. (U. virginiana Lam.)

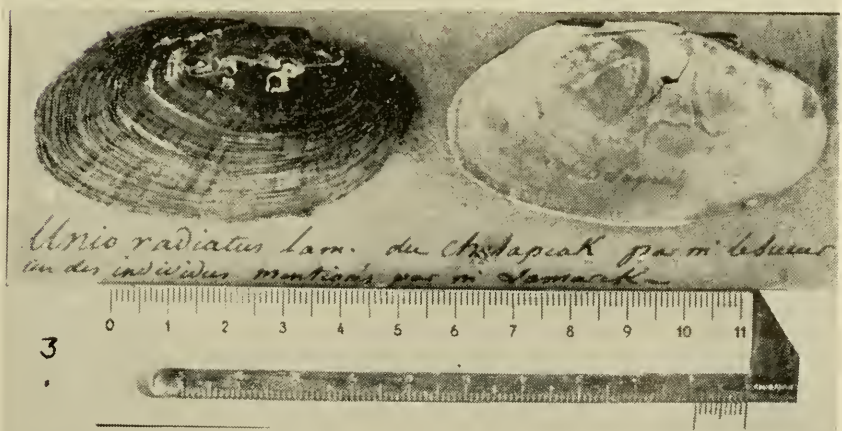
2

Unio radiatus Lam. de la rivière Susquehana par
m^r Michaud. Cet individu d'abord celui qui a été décrit par
Lamarck sous le nom de Unio luteola. (U. virginiana Lam.)

Courtesy of MUSÉUM NATIONAL d'HISTOIRE NATURELLE, PARIS

TYPE of UNIO RADIATUS LAMARCK, 1819

Length 60 MM



Unio radiatus Lam. du Chesapeak par m^r Le Sueur
un des individus montrés par m^r Lamarck

3

Courtesy of MUSÉUM NATIONAL d'HISTOIRE NATURELLE, PARIS

Dr. William K. Emerson, the type of *Unio siliquoideus* Barnes apparently cannot be located. It is believed that Barnes' collection was lost in the fire which destroyed the old New York Lyceum of Natural History. Barnes gave only a bare outline silhouette of his *U. siliquoideus* in his article of 1823 (pl. 5, fig. 15).

In 1833 Isaac Lea went to Paris to examine Lamarck's specimens at the Muséum. In reporting on the type of *U. luteolus* later the same year to the Academy of Natural Sciences of Philadelphia, 1833 (p. 91), he stated:

"From the description and locality, I formerly supposed this to be Say's *cariosa*. On examining this specimen at the Garden of Plants, cited by Lamarck, I found it to be a true *siliquoideus* of Barnes, which sometimes approaches the *cariosus*. . . . Lamarck's name has precedence to that of Mr. Barnes."

The photograph of *U. luteolus* is that of a female, "posterior end broader and rounded" and otherwise fits the description given by Lamarck, 1819 (p. 79). The Paris Museum reports the length as 69 mm., which is also the measurement given by Lamarck. In addition the specimen looks like those known in western New York as *L. luteola* or *L. siliquoidea* and not like *L. cariosa*.

The label is not in the handwriting of Lamarck, according to Dr. E. Fischer, Director of the Laboratory of Malacology of the Paris Museum. Someone else at some time wrote: "Unio radiatus Lam. de la riviera Susquehana par M. Michaud. Cet individu est celui qui a eté decrit par Lamarck sous le nom de *Unio Luteola*. (U. Virginiana Lam.)." The inscription along the interior margin of the right valve is "riv. Susquehana et Mohancks." Lamarck's vision because impaired about 1795 and grew progressively worse until complete blindness overtook him in his later years. By 1819 when he published the portion of his *"Animaux sans vertèbres"* in which the species under consideration were described, he was being assisted by his daughter and by P. A. Latreille who succeeded to part of the Department of Zoology at the Muséum National d'Histoire Naturelle after Lamarck's death in 1829.

The present label certainly could not have been the one which was attached to the type of *L. luteola* when Isaac Lea examined it in 1833, for there is no mention of this synonymy in his report. He surely would have commented on it for, of course, he did

not consider this species synonymous with Lamarck's *L. radiatus.* In fact he stated that the type of the latter "is the true *radiatus,*" 1833 (p. 88), and that his *L. virginiana* "doubtless, is the radiatus described by Barnes." 1834 (p. 425). In the description of his own *L. radiatus,* Barnes listed that of Lamarck's as a synonym, 1823 (p. 265). However Richard I. Johnson reported in 1953 (p. 95) that the figured holotype of *L. virginiana* (Lam.) in the Musée d'Histoire Naturelle de Genève, Geneva, Switzerland, is *Elliptio complanatus* (Solander). In any case *L. virginiana* is not synonymous with *L. luteola.*

Until 1922 authors, generally, accepted Lea's confirmation and statement, using *L. luteola* (Lam.). In that year Ortmann and Walker published a nomenclatural revision of some unionid species. They stated that *L. luteola* could not be used, that the species should now be known by Barnes' name, *siliquoidea.* Their reasons were that "Lamarck's brief description applies better to *cariosa* ('posterior end broader and rounded') and that of the localities given, the first (Susquehanna) has only *cariosa,* but not *siliquoidea.* If the type of *luteola* is the latter, the description is unsatisfactory. In either case the name *luteola* cannot be used." 1922 (p. 62).

The first reason is obviously invalid, as the figure demonstrates. It is a female. In addition it does not look like *L. cariosa.* The second reason is partly invalid as *L. luteola* does occur in the Mohawk, given by Lamarck as one of the localities. The Susquehanna may have been an error, due to one of several factors.

Only one conclusion can be drawn regarding the status of *L. luteola* (Lam.): this name must take precedence over that of *L. siliquoidea* (Barnes), the latter returning to synonymy. The species should hereafter be known as *Lampsilis luteola* (Lamarck), 1819.

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NOTES ON THE GENUS DISCUS

By LESLIE HUBRICHT

Discus catskillensis (Pilsbry).

Pyramidula striatella catskillensis Pilsbry. 1898. Nautilus *12*: 89.

Discus cronkhitei catskillensis (Pilsbry). Pilsbry, 1948. Land Moll. N. Amer. *2*: 605.

Discus catskillensis differs from *D. cronkhitei* (Newcomb) in the distinctly angular periphery of the shell, the larger umbilicus, and in the lighter colored animal. The animal of *D. cronkhitei* is dark gray, while the animal of *D. catskillensis* is nearly white. *D. cronkhitei* is a species of low, wet places; while *D. catskillensis* is usually found in upland woods, but it does occur in low, wet places as well. In the latter habitat, it is sometimes found in company with *D. cronkhitei*. Where they occur together the two species are readily separable. I have seen no evidence of hybridization. The two species have been found living together in northern New York, Michigan, and West Virginia. They also occur together as Pleistocene fossils in the loess at New Harmony, Indiana.

Discus patulus patulus (Deshayes).

Helix patula Deshayes. 1830. Encycl. Méth. *2*: 217.

Gonyodiscus bryantwalkeri Pilsbry. 1924. Proc. Acad. Nat. Sci. Phila. *76*: 420.

Discus bryantwalkeri (Pilsbry). Pilsbry, 1948. Land Moll. N. Amer. *2*: 611.

Discus patulus brooksi Kutchka. 1938. Nautilus *52*: 13.

Discus patulus angulatus Kutchka. 1938. Nautilus *52*: 13. Not *D. macclintocki angulatus* (F. C. Baker), 1928.

Discus patulus carinatus MacMillan. 1940. Nautilus *53*: 143. Not *Helix (Patula) perspectiva* variety *carinata* Gratacap, 1901.

Discus patulus is an extremely variable species, differing in size and number of radial striae, in the elevation of the spire, and in the angulation of the periphery. This variation reaches its peak in eastern Tennessee and northern Alabama. Much of it appears to be due to introgression from *D. nigrimontanus*. I have collected several lots from what appear to be hybrid populations. The primary isolating mechanism between these two species is an ecological one. *D. patulus* is usually found on or about logs and in deep leaves, while *D. nigrimontanus* is a species of rocky places with sparse leaf cover. Hybridization apparently occurs

when a log falls across a rocky place.

At high altitudes in the mountains of western North Carolina, *D. patulus* has much smaller and closer radial ribs. Such specimens resemble *D. bryantwalkeri* except that they have an internal tubercle. Since the type of *D. bryantwalkeri* has a little less than 5 whorls it seems to be only a slightly immature specimen of this high altitude form of *D. patulus.*

D. patulus brooksi with coarse radial ribs, and *D. patulus "carinatus"* with an angular periphery, are forms with some *D. nigrimontanus* admixture. Since they rarely occur in pure colonies and are found sporadically in or near the range of *D. nigrimontanus,* they do not seem worthy of recognition.

Discus patulus edentulus, new subspecies.

Discus patulus form *edentulus* Pilsbry. 1948. Land Moll. N. Amer. *2*: 610, fig. 330c.

Differs from *D. patulus patulus* in having more slender, more loosely coiled whorls, and a larger umbilicus. Usually edentate but often with a small tubercle within the aperture.

This is the form of the Ozark region, which also occurs in Cheatum County, Tennessee.

Pilsbry's form *edentulus* was based on the absence of the internal tubercle, a character of little value. However, the other characters given above were found to be constant in all material from the mountains of western Arkansas and southwestern Missouri.

Discus nigrimontanus (Pilsbry).

Gonyodiscus bryanti nigrimontanus Pilsbry. 1924. Proc. Acad. Nat. Sci. Phila. *76*: 419.

Discus bryanti tuberculatus Kutchka. 1938 Nautilus *52*: 14.

Discus bryanti nigrimontanus (Pilsbry). Pilsbry. 1948. Land Moll. N. Amer. *2*: 613.

Discus bryanti form *tuberculatus* Kutchka. Pilsbry. 1948. Land Moll. N. Amer. II, 614.

I have seen no intergradation between *D. nigrimontanus* and *D. bryanti. D. nigrimontanus* seems more closely related to *D. patulus.*

Discus bryanti tuberculatus is based upon shells with an internal tubercle, but some shells in the type lot of *D. nigrimontanus* also have an internal tubercle. Some admixture with *D. patulus* greatly increases the percentage of shells with the internal tubercle.

REPRODUCTIVE FEATURES OF VALVATA[1,2]

By WILLIAM H. HEARD
Florida State University, Tallahassee

The members of *Valvata* and its family Valvatidae (Gastropoda; Prosobranchia) have long been of special interest largely because they are uniformly hermaphroditic in a group (Subclass Prosobranchia) which is usually dioecious. Most attention has centered around the functional reproductive mechanics (Moquin-Tandon, 1855; Bernard, 1890; Furrow, 1931a, 1931b, 1935), although more recent information (Cleland, 1954; Fromming, 1956) has included broader facets of total reproductive behavior and performance.

It is the purpose of this report to bring together the somewhat scattered literature and to review certain features of the reproductive biology of these aquatic, operculate snails by comparing phenomena exhibited by several species. In so doing, the broader patterns will be emphasized; for information on the functional aspects (e.g., structures, protandry, gametogenesis) the reader is referred to Bernard (1890) and Furrow (1935).

Personal observations were made on several species of *Valvata* from Douglas Lake, Cheboygan County, Michigan. The primary study was made from a mixed population of typical *V. tricarinata* (Say), *V. t. perconfusa* Walker, and *V. t. unicarinata* DeKay. The two latter names represent neither true subspecies nor ecological forms, but apparently genetic polymorphs of *V. tricarinata*. Since the data on these polymorphic forms did not differ significantly from the findings of Furrow (1931b) on the typical *V. tricarinata*, they are presented here as additional information representative of this variable species. I am indebted to Drs. Frank E. Eggleton and Henry van der Schalie for their stimulating advice and criticism during the course of this investigation.

As in many snails, reproduction in *Valvata* is seasonal. In the Great Lakes region of North America, oviposition begins in late spring or early summer and continues into late summer. In this

1 This investigation was supported (in part) by research grant 2E-41 from the National Institute of Allergy and Infectious Diseases, U.S. Public Health Service.
2 A contribution from the University of Michigan Biological Station.

connection the annual *V. piscinalis* of Europe exhibits an interesting migratory behavior which is probably initiated by a combination of the degree of maturity of the gonad and seasonal weather conditions (Cleland, 1954). Immediately prior to egg-laying, these snails leave the substrate and move to the aquatic vegetation where the egg capsules are deposited. Upon hatching, the young feed for a short time on the periphyton and then migrate back to the substrate where they remain until their breeding cycle occurs in the following year. This cycle adheres to a complex pattern. According to Fromming (1956), *V. piscinalis* undergoes 3 periods of oviposition with an interval of about 4 weeks between 2 of these periods. Oviposition in each period, which may extend from 8 to 14 days, occurs 2 to 4 times (depending on the age and nutritional condition of the snail). As a result, the average snail produces about 10 capsules with an approximate total of 150 eggs. There is just one breeding cycle in the life span of this species.

In nature the egg capsules of *Valvata* are found most frequently on aquatic vegetation. When available, however, other objects with smooth surfaces (e.g., stones, twigs, bottles) may serve as favorable sites for egg-laying. Cleland (1954) found that *V. piscinali* showed no preference for any of the following plants as sites for oviposition: *Callitriche verna, Sparganium* sp., *Iris pseudacorus,* and *Nasturtium officianalis.* However, there is a pronounced preference for the site selected for egg-laying by *V. tricarinata.* In a habitat in Douglas Lake, Michigan (Grapevine Point Cove), egg capsules were found attached to aquatic vegetation (*Potamogeton illinoisensis, P. strictifolius, Vallisneria americana, Myriophyllum heterophyllum,* and *Chara vulgaris*) and to leaves of deciduous trees (*Quercus rubra, Betula alba* var. *papyrifera,* and *Acer saccharum*) which covered the surface of a sandy-mud substrate. By means of experiments in which capsule-free samples of each of the above mentioned 8 plants were provided as the only natural substrate, I established that *V. tricarinata* did select certain sites for oviposition. Ten snails were maintained in each container (a four-inch diameter fingerbowl), and the egg capsules deposited on the stem and leaves of each plant were counted and examined. A marked affinity for aquatic plants over leaves of trees was revealed; more capsules were

SPECIES	NO. CAPSULES EXAMINED	NO. EGGS PER MASS	DAYS UNTIL HATCHING	REFERENCE
V. cristata	-	3-4	30-40	C. Pfeiffer (in Fromming, 1956)
	-	4	-	Moquin-Tandon (1855)
	-	2-3	-	Nekrassow (1928)
	-	1-3	-	Fromming (1956)
V. piscinalis	-	4-24	15-30	Moquin-Tandon (1855)
	-	4-24	-	Lavagler (in Fromming, 1956)
	-	16-31, 49	-	Nekrassow (1928)
	-	10-60	-	Germain (1930)
	-	8-19	15	Cleland (1954)
	-	15-40	-	van Benthem Jutting (in Fromming, 1956)
	-	8-22	-	Fromming (1956)
V. tricarinata	80	4-18	12-15	Furrow (1931b)
polymorph perconfusa	293	1-11	7-14	Heard
polymorph unicarinata	5	3-5	-	Heard
V. sincera	6	2-4	5-8	Heard

TABLE 1. FEATURES OF EGG PRODUCTION IN VALVATA SPP.

deposited on the glass finger bowls than on the deciduous leaves (either fresh or partially decayed). Notably the aquatic plants with wider leaves (e.g., *Potamogeton illinoisensis*) contained many more capsules than those with narrow, short, or needle-like leaves (e.g., *P. strictifolius*). Nekrassow (1928) reported egg capsules of *V. cristata* from the leaves of *Stratiotes aloides* and "other plants." All egg capsules of *V. sincera* observed in this investigation (Hook Point Cove of Douglas Lake, Cheboygan Co., Mich.) were recovered from the leaves and stems of aquatic vegetation.

The egg capsules of *Valvata* show a striking contrast with respect to the number of eggs in the capsule and in the time required for hatching (Table 1). These features seem to have diagnostic value for certain species or groups of species. The eggs of *V. cristata* are fewest in number but require the longest period for development, while *V. piscinalis* eggs are greatest in number and have an intermediate hatching time; *V. tricarinata*, s.l., has an intermediate number of eggs per capsule and needs only a short period for development. Too little information exists for *V. sincera* to permit positive conclusions at this time. In snails that breed seasonally, the output of both number of capsules (masses) and number of eggs per capsule increases with time up to a peak, followed by a gradual decline. Unfortunately,

the season of observation is not known for *V. cristata. Valvata piscinalis* (Cleland, 1954) and *V. tricarinata* (Furrow, 1931b) were studied during early and mid-summer when they were at the peak of egg-laying. Data on *V. sincera* were obtained in late summer which was probably in a declining period of oviposition.

The appearance of the egg capsule is similar among all species of *Valvata,* but the internal organization varies somewhat. In all species the fertilized ova are housed in individual egg cases imbedded in a colorless albuminous matrix in the surrounding capsule. During development the greenish embryos fill almost the entire space in the cases, a characteristic feature of *Valvata* (see Nekrassow, 1928). In *V. piscinalis* the case around one egg is continuous with that of the next, its substance being constricted to a thread between the two. In this way all the eggs within one capsule are joined to form a single, continuous string (Cleland, 1954). However, in *V. tricarinata* and *V. cristata,* each egg case has its own individual thread. Pressures exerted by the expanding sizes of the embryos cause the capsules of *V. piscinalis* and *V. tricarinata* to split along a longitudinal suture. In *V. piscinalis* the continuous thread disintegrates as development procedes, and the rupture (1) of the outer membrance of the egg case and (2) the inner egg membrane somewhat later releases the young snails (Nekrassow, 1928). However, in *V. tricarinata* the embryonic snails increase their activity and either wear or eat their way through the membranes of the egg case. Frequently, the hole or tear in the case is not large enough to allow the young snail to free itself, and the animal has been observed to crawl out of the capsule accompanied by the egg case. When the distance of the length of the thread has been traversed, the snail merely pulls away from this anchoring leash. Throughout development the embryo exhibits a conspicuous green color; at hatching the young snail retains this feature only in the digestive gland. The young of *V. tricarinata* emerge with varying degrees of carination of the shell, although those snails which hatched without keels were observed to develop them in a few days.

Information bearing on the basic biology of *Valvata* is almost entirely wanting, and life history studies concerning life span, ability to self-fertilize, viability of eggs, and total reproductive behavior are unknown or at best incomplete for most species.

Surprisingly these features have been accorded little attention in a group of snails of such widespread and common occurrence. Intensive seasonal field studies should be supplemented by laboratory observations to provide a more accurate and complete account of the biology of these animals.

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MOLLUSKS FROM A BUOY OFF GEORGIA

By ARTHUR S. MERRILL[1]

A recent publication by Galtsoff and Merrill (1962) on the shell morphology, growth, and distribution of *Ostrea equestris* was based principally on a study of the oysters taken from a buoy off the Georgia coast. The present paper discusses all other species of mollusks found on this buoy.

The buoy was examined at the United States Coast Guard Station, Charleston, South Carolina, where it had been brought in for servicing. It had been moored offshore from the St. Mary's River entrance, 30°42'5" N. latitude, 81°19'2" W. longitude, about 6 miles from the nearest land point of Amelia Island, Georgia, at a depth of 30 feet. The buoy had been in the water from 28 February, 1957 to 16 November, 1960.

There was a wealth of molluscan fauna within the stabilizer tube of the buoy (see illustration of buoy stabilizer tube in Merrill, 1959). Especially noteworthy was the predominance of *Ostrea equestris,* but equally impressive were the great numbers

[1] Bureau of Commercial Fisheries Biological Laboratory, Woods Hole, Massachusetts.

of several other species, mostly very small specimens. These occupied an area of about 50 square feet in the tube and all were carefully removed with the assistance of Mr. Richard Spencer of North Charleston, South Carolina.

The mollusks have since been sorted and measured. The size range of some species indicates recent setting. Many individuals are so small that the larval and early postlarval shell characteristics are easily recognizable. Some of the species are so numerous as to permit the arrangement in series of juvenile growth for studies of early shell morphology and variation. In fact, a series of one species, *Lithophaga bisulcata,* has already been described and figured in a study by Turner and Boss (1962).

The mollusks collected from the buoy are listed below with annotations. Greatest overall measurement, either height or length, is used. The pelecypods are deposited at the Museum of Comparative Zoology, Harvard University, where they are readily accessible.

Pelecypoda.

Ostrea equestris Say: 820 specimens measuring 4.0 to 82.0 mm. with two modes at about 15.0 and 48.0 mm.

Chama macerophylla Gmelin: 6 specimens from 3.0 to 10.0 mm.

Noetia ponderosa (Say): 535 specimens from 0.5 to 5.0 mm. with a mode at about 2.5 mm.; 12 specimens over 5.0 mm. to 33.0 mm.

Gastrochaena hians Gmelin: 1 specimen 6.8 mm.

Brachidontes exustus (Linne): 3410 specimens 0.6 to 14.8 mm., mode at 2.5 mm.

Modiolus americanus Leach: 144 specimens 0.9 to 12.8 mm., modes at 2.5 and 5.5 mm.

Musculus lateralis (Say): 38 specimens 2.0 to 8.1 mm., mode at 5.0 mm.

Pododesmus rudis Broderip: 5 specimens 14.5 to 41.5 mm.

Lithophaga bisulcata Orbigny: 11 specimens 1.8 to 18.0 mm.

Gastropoda. The gastropods include 7 larval specimens less than 1 mm. long and one adult pteropod about 5 mm. long. These were sent to Dr. Robert Robertson of the Academy of Natural Sciences of Philadelphia for examination. The larval specimens, too small for positive identification, comprise 4 high spired forms, possibly columbellids, and 3 low-spired ones, possible naticids. The pteropod was identifiable. All the gastropods were catalogued into the A.N.S.P. mollusk collection as follows:

Cavolina longirostris (Lesueur) Cat. No. 255011.
?Polinices (Neverita) duplicata (Say) Cat. No. 255012.
?Mitrella lunata (Say) Cat. No. 255013.

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AMERICAN MALACOLOGICAL UNION
TWENTY-NINTH ANNUAL MEETING

On June 18th and for the third time in its history, members of the American Malacological Union convened as guests of the Buffalo Society of Natural Science, and its Conchological Section.

The four-day meeting was as always an unqualified success. High lights included a dinner at the University of Buffalo followed by a film portraying underwater denizens in all their fantastic beauty; a charming reception tendered by the Buffalo Museum of Science and the Conchological Section, followed by the annual dinner, and finally an all-day tour of Niagara Falls and the adjacent points of interest.

A total of 95 persons registered, and in twice-daily sessions for the first 4 days enjoyed an unusually fine and varied program consisting of the following papers:

Malacology in 1963. William J. Clench.
Brief history of shell interest and American shell clubs. Katherine V. W. Palmer.
Collecting on Cocos-Keeling, Indian Ocean. Virginia Orr.
Some unexplored collecting localities in El Salvador. Morris Karl Jacobson.
Shell orchestra. Eugene Musial.
Some living mollusks. Dorothy Raeihle.
Pacific snail trail, a malacologist's journey from Hawaii to New Zealand. Alan Solem.
Expedition to the Bay of Bengal. R. Tucker Abbott.
Problems of species analogues in world Littorinidae. Joseph

Rosewater.

The Genus Agaronia (Olividae). John Q. Burch.

Notes on American *Siphonaria*. J. P. E. Morrison.

The genus *Conus* in the Southern Caribbean. H. E. Coomans.

Variation and subspecific divisions, within *Aequipecten irradians* (Lamarck). Arthur H. Clarke, Jr.

Shells and their keepers: a world tour of museum mollusk collections. Alan Solem.

Larval shells of the Architectonicidae. Robert Robertson.

Observations on embryonic shell sculpture of some freshwater snails, *Amphigyra* and *Neoplanorbis* in particular. H. J. Walter.

Some notes on the regeneration of shell in *Oncomelania formosana*. George M. Davis (read by Robert H. Wakefield).

Cytological studies of pomatiopsid snails. Charlotte M. Patterson.

A cytological study of African bulinine snails, vectors of urinary schistosomiasis. John B. Burch.

Natural and experimental infection of Louisiana snails with the blood flukes. Emile A. Malek.

Studies of the biology of *Pomatiopsis* and *Oncomelania,* snail intermediate hosts of Oriental blood fluke *(Schistosoma japonicum).* Henry van der Schalie.

Preliminary report—Pleistocene non-marine Mollusca of northeastern Wisconsin. Edward C. Roy, Jr.

Preliminary report on Pleistocene freshwater Mollusca from the Gaspé Peninsula, Quebec, Canada. Joseph F. Schwietering.

The distribution, ecology and life history of the mussel, *Actinoniasis ellipsiformis* Conrad, in Michigan. Henry van der Schalie.

Notes on the naiad fauna of the Olentangy River in central Ohio. Carol B. Stein.

Changes in the pelecypod populations in the salt fork of the Big Vermilion River in Illinois, 1918-1962. Ralph W. Dexter and Max R. Matteson.

An introduced slug. Dolores S. Dundee.

Otala lactea (Müller) life history. Bernice Plummer.

Disease, decline and predation in the giant snail populations of Hawaii. Albert R. Mead.

Report of progress on a new Nautilus index. Aurele LaRocque.

Some local shells. Morley Bishop and Eugene Musial.
Colloquium: the expanding frontiers in malacology. (Comprising the following five papers):
New marine frontiers. Arthur H. Clarke, Jr.
New freshwater frontiers. Emile A. Malek.
New tropical frontiers. William J. Clench.
New desert frontiers. Albert R. Mead.
New frontiers in taxonomic criteria. John B. Burch.

The following officers were elected to serve in 1964, at which time the annual meeting will be held at Louisiana State University in New Orleans:

President, John Q. Burch. Vice-president, Juan J. Parodiz. Second Vice-President, A. Myra Keen. Secretary, Margaret C. Teskey. Treasurer, Jean M. Cate. Publications Editor, Morris Karl Jacobson. Councillors-at-Large: Wendell O. Gregg, Arthur S. Merrill, Dorothy Raeihle, Ernest J. Roscoe.

Margaret C. Teskey, Secretary, American Malacological Union

NOTES AND NEWS

Dr. Merrill E. Champion of Cambridge, Mass. died June 27, 1963, at the age of 83. Since 1943, he was an associate in the Dept. of Mollusks, Museum of Comparative Zoölogy at Harvard.

Correction of the type locality of *Euglandina dorsalis*.—In a current issue of the Nautilus (vol. *76*: 97-99) I listed the type locality of *Euglandina (Guillarmodia) dorsalis* Thompson as one mile north of Pomero, Michoacan. This should be corrected to one mile north of Pomáro, Michoacan. The field label from which the data had been taken was in error, and it was not until after my article had been published that the error was brought to my attention by William E. Duellman, of the University of Kansas.—Fred G. Thompson.

Triodopsis fosteri in Ohio.—In May, 1961, I collected *Triodopsis fosteri* (F. C. Baker) on an embankment near a stream on the floodplain of the Ohio River, at the southeast edge of California, Hamilton Co., Ohio. Aside from the obvious and well-recorded introductions on the Atlantic Coast, this record is the farthest east for this common Mississippi Valley snail. It may have been introduced at this locality also. — F. Wayne Grimm.

THE NAUTILUS

Vol. 77 January, 1964 No. 3

ANATOMY OF THE SUCCINEID GASTROPOD OXYLOMA HAYDENI

By DOROTHEA S. FRANZEN
Biology Department, Illinois Wesleyan University

Oxyloma haydeni (W. G. Binney) was first collected by F. V. Hayden, M.D. In the years of 1855-1857 he accompanied the expedition of Lt. G. K. Warren in the exploration of an area which included the Nebraska Territory (Hayden, 1858, pp. 139-158, map). Dr. Hayden served the expedition as physician, geologist and naturalist.

Dr. Hayden designated the locality from which he obtained the specimens now known as *O. haydeni* as "Habitat in provincia Nebraska, frequens inter flumina 'Loup Fork', et 'L'eau qui court'" as reported by Binney (1858, p. 114) in the original description of *haydeni*. The "Loup Fork" is now known as the Middle Loup River and the "L'eau qui court" as the Niobrara River. To obtain succineids identifiable as *O. haydeni* from the probable vicinity where Dr. Hayden may have found them, I collected from a series of localities in the vicinity of the city of Valentine, Nebraska, and southward to the North Platte River, between 100°15′ and 100°50′ west longitude. The strip was selected because U. S. Highway 83 crosses the Sand Hill area through the region of a series of lakes which are located between the Niobrara and the Middle Loup Rivers. To date I have obtained *O. haydeni* from 13 stations in Nebraska of which 12 are located from a few miles north of the city of Valentine to a few miles south of the city of North Platte. The westernmost station is at the Rock Creek Fish Hatchery, Dundy County, Nebraska.

The collecting stations, together with brief descriptions of their local ecology, listed in north to south geographic order are:

1. Three and one-half miles NE Valentine, Nebraska, along the shore of the Niobrara River at the base of a marl cliff. The shore supported a growth of sawgrass (*Spartina* sp.).

2. Two and one-half miles NE Valentine, Nebraska, shores of ponds at the Nebraska State Fish Hatchery. The shores were cov-

ered with grasses and shaded by trees, predominately oak and cottonwood.

3. The city park, Valentine, Nebraska. The locality, a hillside off shore of Minnechaduza Creek, a tributary of the Niobrara River, was shaded and wet because of drainage down the slope. The snails were living on the wet ground under sawgrass (*Spartina* sp.).

4. Seventeen miles S and 15 miles SW Valentine, Nebraska, Duck Lake, Valentine Migratory Waterfowl Refuge. The snails were creeping among the reeds, cattails (*Typha* sp.) and arrowhead (*Sagittaria* sp.) on the very wet shore of the lake.

5. Seventeen miles S. and 17 miles SW. Valentine, Nebraska, Pelican Lake, Valentine Migratory Waterfowl Refuge. The shore of the lake was covered with a dense growth of *Typha* sp. and *Sagittaria* sp. The snails were found living on the very wet ground.

6. Twenty-one miles S. Valentine, Nebraska, alongside U. S. Highway 83. The snails were found under dead leaves of *Spartina* sp., reeds, and *Typha* sp. growing in a marsh bordering a lake.

7. Twenty-two miles S. Valentine, Nebraska, shore of a lake located about five hundred feet west of U. S. Highway 83. The wet, unshaded lake shore supported a growth of sedges. The growth was not dense; therefore, the snails were exposed to the sun.

8. One mile W. and ¾ mile S. Halsey, Nebraska. The locality is a sandy-loam bar extending into the Middle Loup River. The snails were living on short sedges and on the wet ground. The bar was not shaded by trees.

9. One-fourth mile S. Thedford, Nebraska, along the shore of the Middle Loup River. Part of the shore was shaded by locust, cottonwood, and willow trees. The soil was a sandy-loam. The snails were found among the sedges, reeds, *Typha* sp. and *Sagittaria* sp. growing on the low flood plain.

10. One mile W. Thedford, Nebraska, near State Highway 2. The locality is a depression in the flood plain of the Middle Loup River. The snails were living on the wet, soggy ground.

11. Two miles S. the Platte River, North Platte, Nebraska, Nebraska State Fish Hatchery. The locality is the grass-covered shore of the edge of a fish hatching pond. The shore was shaded

by willow trees.

12. The location is the same as Station No. 11, but the habitat is the edge of a ditch draining the fish hatching ponds. The edge of the ditch was covered with tall grasses. *Typha* sp. grew in the water.

13. Eight miles W. Parks, Dundee County, Nebraska, Rock Creek State Fish Hatchery. The snails lived along the fish hatching ponds on the wet ground among the growth of *Typha* sp.

These localities were visited in the month of July in the summers of 1961 and 1962. The snails were mature and sexually active. *Oxyloma haydeni* was not found in eastern Nebraska nor in eastern Colorado; further collections will be necessary to determine the extent of its geographic distribution.

The Shell. The thin, glossy, amber-colored, elongate-ovate shell consists of about 3 convex, sharply-incised whorls. From the arcuate base of the aperture the shell becomes gradually inflated towards the upper third of the ultimate whorl and then tapers to form a pointed spire. The large aperture, equal to about 5/7 of the entire length of the shell, is elongate-ovate, becoming sharply attenuated toward the spire. The sharp peristone becomes roundly infolded along the inner border of the ultimate whorl and is continuous with the columella. In some shells the columella emerges below the apex of the aperture and continues along the margin of the ultimate whorl in the form of a white spiral plait such as that occurring also in *Oxyloma retusa* (Lea) (Franzen, 1963, p. 86).

The nuclear whorl is finely punctate. The growth striae are fine and evenly spaced on the nuclear whorl. The penultimate whorl is marked with fine, closely-spaced striae and coarser irregularly-spaced ridges and furrows. On the ultimate whorl the striae are coarser, the irregularly-spaced ridges heavier and the furrows deeper and wider, resulting in a rough surface.

The range in height and width of the shell, ratios of those two dimensions, the size of the aperture, and ratios of the height of the aperture to its width as well as ratios of the dimensions of the aperture to corresponding shell dimensions are to be noted in Table I. The sizes of the shells are those of the largest taken from each respective station. The maximum sizes attained cannot be correlated with either the northern or the southernmost range.

TABLE I

Measurements of Shells of Oxyloma haydeni (W. G. Binney)

STATION	No. of Whorls	Height	Width	Width/ Height	Height of Aperture	Width of Aperture	H. Ap./ H. Shell	W. Ap./ W. Shell	W. Ap. H. Ap.
Paratypes									
S. I. 39749	3-5/8	21.3 mm.	11.2 mm.	.525	15.5 mm.	8.8 mm.	.727	.785	.567
S. I. 8659	3-1/4	21.5	10.2	.474	16.1	8.3	.744	.813	.515
1. 3-1/2 mi.	3-1/8	13.7	6.7	.489	9.8	5.5	.715	.821	.561
NE Valentine,	3	13.6	6.6	.485	10.2	5.6	.750	.848	.550
Nebraska	3	12.0	5.7	.475	9.6	5.1	.800	.894	.531
2. 2-1/2 mi.	3-1/2	14.6	7.8	.534	10.5	5.9	.719	.756	.561
NE Valentine,	3-1/4	14.6	7.8	.534	10.9	6.1	.746	.782	.559
Nebraska	3-1/4	14.3	7.4	.517	10.8	6.1	.755	.824	.564
3. City Park	3-1/8	14.5	6.8	.469	10.0	5.8	.690	.853	.580
Valentine,	3	11.2	6.2	.553	8.5	5.5	.759	.887	.647
Nebraska	3	11.1	6.0	.540	8.1	5.0	.730	.833	.617
4. Duck Lake	3-1/4	18.2	9.5	.522	13.5	8.3	.741	.873	.615
	3	16.5	8.0	.484	12.5	7.3	.757	.912	.584
	3	15.2	7.8	.513	11.5	6.7	.756	.859	.582
5. Pelican	3-3/8	20.3	10.2	.502	15.5	9.0	.763	.882	.580
Lake	3-1/4	20.2	9.7	.480	15.7	9.0	.777	.927	.573
	3-1/4	20.0	9.6	.480	15.0	8.7	.750	.906	.580
6. 21 mi. S	3-1/2	16.6	7.4	.445	12.0	6.5	.722	.878	.541
Valentine,	3-1/4	16.5	7.4	.448	12.2	6.5	.739	.878	.532
Nebraska	3-1/4	15.8	7.5	.474	12.0	6.6	.759	.880	.550
7. 22 mi S	3-1/4	22.7	9.8	.431	16.1	7.7	.709	.785	.478
Valentine,	3-3/8	22.6	10.5	.464	16.6	8.5	.734	.809	.512
Nebraska	3-3/8	21.9	9.8	.447	15.2	7.2	.694	.734	.473
8. 1 mi. W,	3-1/4	12.5	6.6	.528	9.0	5.5	.720	.833	.611
3/4 mi. S	3	11.5	6.0	.521	7.9	4.6	.687	.766	.582
Halsey, Nebr.	3	11.5	6.0	.521	8.2	4.6	.713	.766	.561
9. 1/4 mi. S	3-1/4	20.0	10.0	.500	15.4	9.0	.770	.900	.584
Thedford,	3	17.9	9.1	.508	14.0	8.0	.782	.879	.571
Nebraska	3-1/4	17.3	8.9	.514	13.0	7.4	.751	.831	.569
10. 1 mi. W	3-1/4	16.0	7.6	.475	11.5	6.7	.718	.881	.582
Thedford,	3-1/8	15.5	7.8	.503	11.1	6.8	.716	.871	.612
Nebraska	3-1/8	15.4	7.5	.487	10.8	6.5	.701	.866	.602
11. 2 mi. S	3-5/8	10.5	5.8	.552	6.2	4.6	.590	.793	.742
Platte River,	3-1/2	10.0	5.8	.580	6.4	4.6	.640	.793	.718
N. Platte, N.	3-1/2	9.5	5.2	.547	6.0	4.4	.631	.846	.733
12. 2 mi. S	3-1/4	18.7	8.6	.460	13.0	8.0	.695	.930	.615
Platte River	3-1/4	18.5	8.7	.472	13.3	7.5	.719	.862	.564
N. Platte, N.	3-1/4	17.4	8.0	.460	12.6	7.3	.724	.912	.580
13. 8 mi. NW	3-1/4	15.3	7.5	.490	11.1	6.4	.725	.853	.576
Parks, Nebr.	3-1/4	14.0	8.2	.585	10.8	7.0	.771	.853	.648
	3-1/8	13.7	6.6	.481	10.7	5.7	.781	.863	.532

The measurements are of the 3 largest shells of each of the 13 stations. In the 4th column of measurements are listed the ratios of the width of the shell over its height. In the last 3 columns are listed the ratios of the height of the aperture over the height of the shell; width of aperture over width of shell; width of aperture over height of aperture.

The largest shells were taken from Station 7, 22 miles south of Valentine, Nebraska. The dimensions of those shells approach more nearly those of the two paratypes which were measured. The paratypes, borrowed from the Smithsonian Institution, are (according to their labels) from "between Loup Fork and Big Rapid River" (the Niobrara River).

Description of the Body Wall and Mantle. The body wall is light cream colored, finely and irregularly tuberculate, and pigmented with patches of black flecks. The pattern of the distribu-

tion of the pigment on the dorsal anterior-most surface of the head varies. On some individuals the patches anterior to the posterior tentacles form indistinct bands which radiate laterally from the mid-dorsal line. On others the patches on the anterior part of the head are scattered, forming no discernible pattern anterior to the posterior tentacles. Posterad, the pigment patches converge between the posterior tentacles, and from there they fan out to form three double-rowed bands which extend across the posterior dorsal surface of the body terminating within 0.5-1.0 mm. of the attachment of the mantle to the body wall. On occasional individuals the pigmentation is so sparse that the bands are scarcely discernible. Patches of pigment are scattered along the lateral surface of the body wall. The pigmentation may be concentrated on the upper and anterior portion or may extend over the entire surface continuing over the ventral surface of the foot. The pigmentation of the lateral body wall does not tend to form a band as in *Oxyloma retusa* (Franzen, 1963, p. 88).

The mantle is generally darkly speckled. Anteriorly the pigmentation may produce an irregularly banded effect extending to the edge of the mantle collar. Or the pigmentation may extend to the anterior edge of the mantle interrupted only by some white patches. The collar may be free of pigmentation or may be speckled. Through the mantle, the kidney is seen as an orange band following the contour of the body. Usually a darkly pigmented band on the mantle outlines the posterior margin of the kidney.

Towards the ventral margin of the body, shallow vertical grooves incise the pedal groove and the very shallow suprapedal groove producing a series of shallow scallops along the ventral margin, especially when the animal is in a partially contracted state. The genital aperture is a slit (in contracted individuals it may assume the form of a crescent) ranging in length from 0.8 to 1.2 mm. and is surrounded by an oval, tumid lip on which usually are scattered flecks of pigment.

The Radula. The structure of the radula bears the general generic characteristics. In the radulae studied, the number of rows of teeth ranged from 66-96. The number of teeth in a row, as well as the number of laterals and marginals, vary. The ratio of the marginals to laterals approaches 1:3 and 1:4 (Table II). This is simi-

TABLE II

Station	No. of Rows of Teeth	Row	Tooth Formula
22 mi. S Valentine	(a) 96	63	41 - 10 - C - 8 - 44
	(b) 97	36	C - 10 - 36
		74	30 - 12 - C - 11 - 38
1 mi. W Thedford	92	69	22 - 10 - C - 8 - 32
2 mi. S Platte River at North Platte	77	12	9 - 8 - C - 9 - 8
		43	? 9 - C - 9 - 42
		49	43 - 8 - C - 9 - 43
		50	43 - 8 - C - 9 - 43

Counts made of representative radulae to show variations in the number of rows of teeth in a radula and variations of the number of teeth in a row.

lar to what has been reported of *Oxyloma retusa* (Franzen, 1962, Table II, p. 89).

The central tooth has the structural characteristics of the succineids, namely, a mesocone flanked on either side by an ectocone. The laterals have a mesocone and an ectocone. Occasionally an endocone is present in laterals near the marginals. The marginals have an endocone, a mesocone, and an ectocone; the last is characteristically divided into three cusps. In the most medial marginals an endocone may be wanting and the ectocone may be divided into only two cusps. In the outermost marginals the lateral cusp of the ectocone tends to be longer than the other two. The length and shape of the basal plate is also characteristic of the genus in being longer and more tapering than that of *Succinea* and *Catinella* (Quick, 1933, p. 296, figs. 1-4; Franzen, 1959, p. 195, fig. 3).

The Jaw. The amber colored jaw resembles that of *Oxyloma retusa* (Lea). A large median fold projects anteriorly. The small lateral folds, characteristic of the jaw of *Succinea ovalis* Say (Franzen, 1959, p. 194, fig. 2), are wanting in *O. haydeni* as in *O. retusa*. No characteristics were noted which would serve to distinguish the jaws of these two species.

The Reproductive System. The elongate penis is encased in a slightly speckled sheath. The vas deferens enters the sheath at its posterior extremity. The stout penial retractor muscle is here

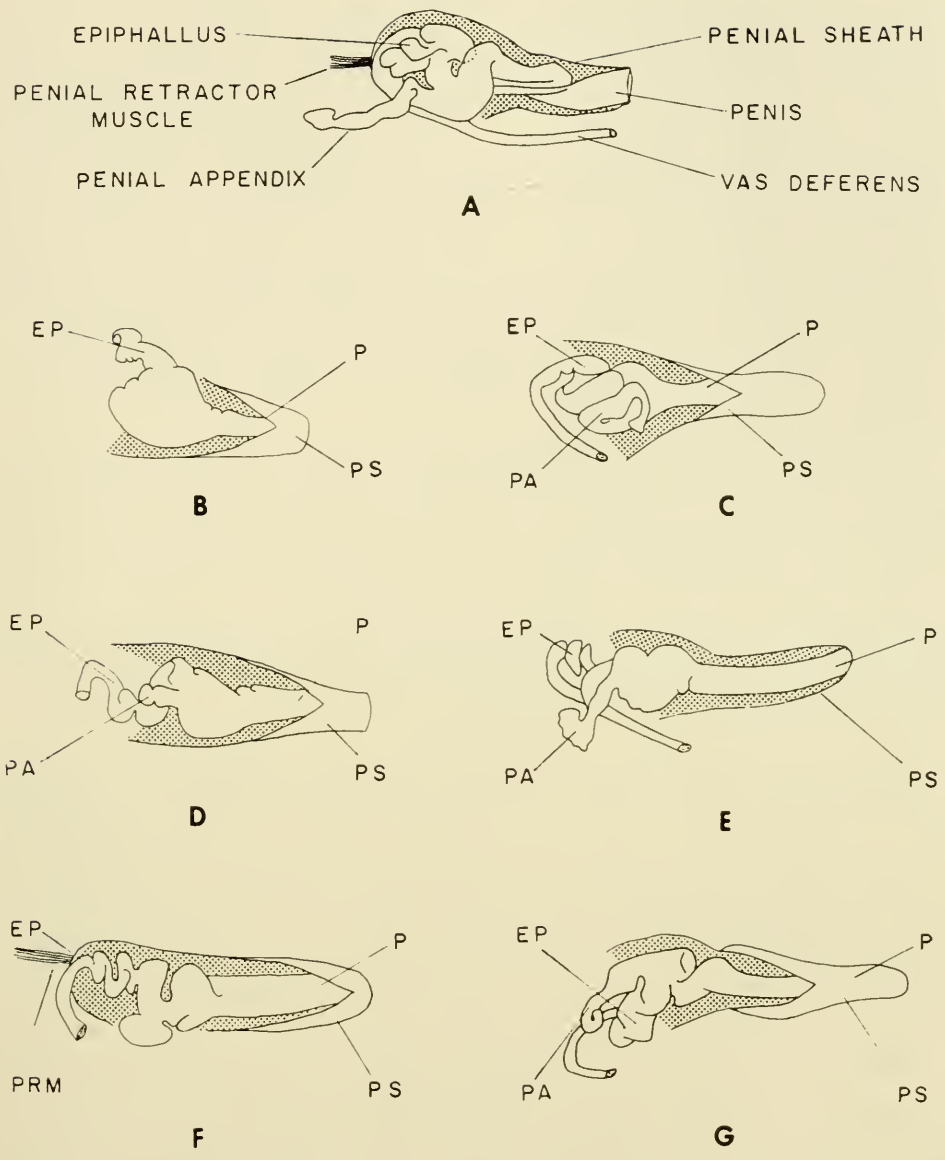

Figure 1.—Penis shown inside of penis sheath cut open. All figures 7x. The figures are from snails taken from the following stations: A. One-fourth mile S. Thedford, Nebraska; B. Duck Lake; C. Twenty-two miles S. Valentine, Nebraska; D. Duck Lake; E. Pelican Lake; F. Duck Lake; G. One-fourth mile S. Thedford, Nebraska.

attached. The epiphallus, the vas deferens after its entry into the sheath, continues as a coiled structure and enters the penis just anteriorly to the terminal appendix as shown in Figure I, A. The appendix is bulbous at its base but becomes an elongate, digitiform structure ranging in length from 0.6 to 1.2 mm. Its terminus is either broadly rounded or in the form of a blunt hook. Such an

appendix was found to occur consistently in all of the populations studied with the exception of station 4 known as Duck Lake. The individuals studied from this locality were found to have a bag-like structure entirely without an appendix (Figure I, B, F) or with a short, blunt appendix (Figure I, D) instead of a digitiform appendix. This is probably the result of a mutation persisting in an isolated, inbreeding population. To date this variation has been found to be restricted to this one population.

The penial sheath and the vagina are approximately equal in length. The oviduct and the duct from the seminal receptacle enter the vagina terminally.

The albumin gland is about ¾ the length of the elongate-oval prostate gland. The acini of the prostate gland are about twice the size of the albumin gland. The lobes of the twinned seminal vesicles are subequal to unequal in length with either the right or the left lobe being the larger. Pigmentation of the lobes is variable as is that of the hermaphroditic duct. In all of these features *O. haydeni* does not differ from *O. retusa*.

Summary

Oxyloma haydeni (W. G. Binney) and *O. retusa* (Lea) cannot be distinguished by characters of their shells. The sizes and ratios of the several dimensions of the shells of these two species show no significant differences in their ranges of variation (Table 1: Franzen, 1963, p. 87). Other shell characters, as well, are shared by these two species. The radulae and jaws, likewise, lack unique features.

Anatomical features which distinguish *O. haydeni* from *O. retusa* are: 1. Differences in the pattern and degree of intensity of the pigmentation of the body wall: The pigmentation along the lateral body wall of *O. haydeni* does not assume the form of a broad band as it does in *O. retusa* and overall pigmentation in *haydeni* tends to be lighter than in *retusa*. No darkly pigmented individuals of *haydeni* have been found as has been reported for *retusa* (Miles, 1958, pp. 1522-1523; Franzen, 1963, p. 88). 2. Length of the penial appendix: The consistently long, digitiform penial appendix of *haydeni* is readily distinguishable from the generally short (but highly variable) penial appendix of *retusa*. The degree of variation in the length of the penial appendix exhibited in *O. retusa,* within any single population and in general,

has not been noted to occur in *O. haydeni*. Even when the penial appendix of *O. retusa* is relatively elongate, its length is not comparable to that of the penial appendix of *O. haydeni* (Franzen, 1963, Figure 3, A, B).

Geographic distribution: The eastern limits of the geographical range of *O. haydeni* are not known to extend into the western range of *O. retusa,* although the two species occupy similar habitats within their respective ranges (Franzen, 1963, pp. 84-85).

Acknowledgments: This study has been made possible through the financial assistance of a National Science Foundation Grant-in-Aid. The study of paratypes of *Oxyloma haydeni* (W. G. Binney) was possible through the courtesy of Harald A. Rehder, Curator, Division of Mollusks, Smithsonian Institution, U. S. National Museum. I am grateful to A. Byron Leonard for the reading of the manuscript and for making helpful suggestions.

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MOLLUSCAN FAUNA OF SOME ALKALINE LAKES AND SLOUGHS IN SOUTHERN CENTRAL NORTH DAKOTA

By SAMUEL J. TUTHILL and WILSON M. LAIRD

(Continued from October no.)

Description of the locations

A number is assigned to each location to facilitate discussion. Summaries of the faunal content and the water chemistry of each location may be found on table 3 and 2 respectively. The range

Table 4. Summary of Range of Ecologic Conditions for each Species of Mollusk.

Characteristic	Gyraulus parvus	Lymnaea palustris	Physa sp.	Gyraulus sp.	Helisoma trivolvis	Promenetus exacuous	Lymnaea humilis
pH	6.23 8.50	6.23 8.75	6.23 8.75	7.50 8.75	6.23 8.75	7.50 8.75	7.70 8.20
Temp. °C	9.6 10.6	9.4 10.6	9.4 10.8	9.4 10.0	10.0 10.8	9.4 10.0	10.0 13.0
ALKALINITY							
Total	96	96	96	170	96	170	170
ppm	1145	1145	1145	1145	990	1145	990
CO_3	0	0	0	0	0	12	0
ppm	214	214	64	40	38	214	38
HCO_3	96	96	96	132	96	132	132
ppm	1133	1133	1133	1133	958	1133	958
CO_2							
Total	80	80	80	150	80	150	150
ppm	1000	1000	1000	1000	870	1000	870
Free	0	0	0	0	0	0	0
ppm	110	110	110	0	110	0	0
TOTAL SOLIDS	180	180	180	2600	180	2280	830
ppm	5210	5210	5000	5000	5000	5210	15800
BOTTOM TYPE	gel-cr. sand	gel-cr. sand	gel-cr. sand	gel-cr. sand	gel-cr. sand	gel-cr. sand	gel-fine sand

of ecologic conditions for each species of mollusk is shown on Table 4. Three factors of selection may be regarded as recognizable biases in this study. The first was proximity of the location

Armiger crista	Pisidium sp.	Lymnaea stagnal.	Aplexa hypnorum	Valvata tricarinata	Amnicola limosa	Helisoma anceps	Sphaerium sp.
7.97 8.20	7.50 8.20	8.23	7.97	7.97 8.50	7.97	7.97	8.75
10.0 10.0	10.0 10.0		10.0	9.6	10.0	10.0	9.4
170 990	170 1145	345	170	170 853	170	170	204
32 38	12 38	0	38	38 214	38	38	40
132 958	132 1133	345	132	132 639	132	132	164
150 870	150 1000	300	150	150 740	150	150	180
0 0	0 0	0	0	0	0	0	0
3150 4730	2280 4730	470	4730	4730 5210	4730	4730	5000
gel– fine sand	gel– cr. sand	fine sand	gel	gel– clay	gel	gel	fine sand

to exposures of Pleistocene deposits containing fossil mollusks. Second, the number of basic types of aquatic environments available for study in the area is limited to permanent and ephemeral

sloughs and shallow lakes. And third, time available for the field work was limited to three days, therefore necessitating selection of bodies of water adjacent to passable roads.

Location 1. Nue Farm Slough; SW ¼ Sec. 31, T. 130 N., R. 67 W., McIntosh County. This pond contains water through the dry seasons, but is so alkaline at all times that it is not potable even for stock use. Rushes line most of the shoreline and abundant aquatic vegetation grows in the slough. The bottom is a black noisome muck. This pond is in the Missouri Coteau district.

Fauna: *Lymnaea* cf. *L. humilis*

Location 2. Lake Hoskins; N ½ Sec. 33 and S ¼ portion Sec. 28, T. 130 N., R. 70 W., McIntosh County. Lake Hoskins remains full of water throughout the driest season. Its position in outwash sediments is probably the reason for its permanence. *Lymnaea palustris* dominates the fauna, being twice as abundant as any other species. Large mats of aquatic vegetation cover almost the entire lake surface. Rushes are abundant along the shoreline. Lake Hoskins is situated in the Missouri Coteau district.

Fauna: *Physa* sp. *Lymnaea palustris. Gyraulus* sp. *Helisoma trivolvis. Sphaerium* sp.

Location 3. Green Lake; S ¾ portion Sec. 32, S ½ Sec. 33, T. 132 N., R. 70 W., and NW ¼ Sec. 4, N ⅓ portion Sec. 5, T. 131 N., R. 70 W., McIntosh County. Green Lake had algae filled waters at the time of sampling. It does not dry up during the dry season. Like Lake Hoskins it lies in outwash sediments which probably account for its stable water level. Aquatic and marginal vegetation is abundant. This lake is located in the Missouri Coteau district.

Fauna: *Lymnaea palustris. Gyraulus* sp. *Pisidium* sp.

Location 4. Mummy Cat Slough; E ½ portion Sec. 10, SW ¼ Sec. 11, T. 132 N., R. 69 W., McIntosh County. This slough has steep banks on its southwest margins which are probably wave modified ice-contact faces which indicate the basin is a large kettle in a perched lake plain (of late Pleistocene age) covering approximately 40 square miles of the area. Water rarely stands in this slough. Marsh vegetation abounds. The snails were taken in organic matter and muds from a ditch along an overgrown section line trail between Sec. 10 and Sec. 11.

No water was standing in the ditch but living specimens of

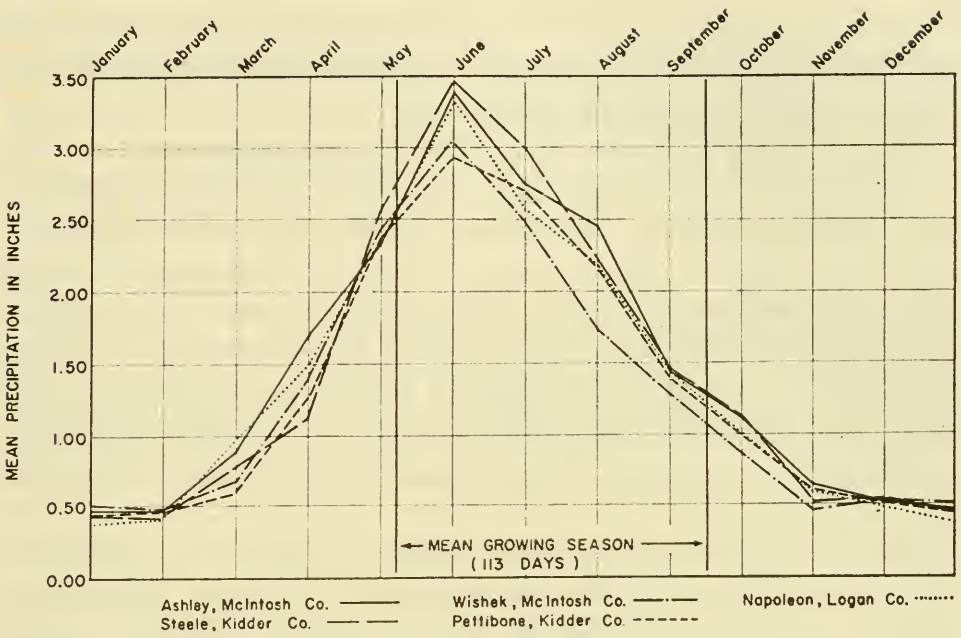

Figure 2.—Frequency polygon showing the mean monthly precipitation in the area of this study. The mean growing season for the area is assumed to be the approximate activity period for aquatic mollusks and is indicated above by two vertical lines.

Aplexa hypnorum and *Lymnaea palustris* were taken. All others were represented by fresh shells. This slough is located in the Missouri Coteau district.

Fauna: *Physa* sp. *Lymnaea palustris. L. stagnalis. Gyraulus parvus. Helisoma trivolvis. Aplexa hypnorum. Armiger crista.* Land snails: *Gastrocopta armifera,* a fragment probably from a species of *Discus* and *Euconulus* cf. *E. fulvus.*

Location 5. Slough; NW ¼, NW ¼, NW ¼ Sec. 13, T. 133 N., R. 71 W., Logan County. This slough is in the Coteau Slope district. It is a 3- or 4-year-old stockpond behind an earth dam in a tributary to the Beaver Lake drainage system. The lower pH, total alkalinity, total dissolved solids and coarser grain size are probably due to the short time the pond has existed.

Fauna: *Physa* cf. *P. integra. Lymnaea palustris. Helisoma trivolvis.*

Location 6. Slough; NE ¼, NE ¼, NE ¼ Sec. 35 and NW ¼ Sec. 36, T. 134 N., R. 71, W., Logan County. This slough is probably ephemeral, being a pond in a low portion of the Beaver Lake drainage. It is situated in the Coteau Slope district. The high alkalinity values suggest the ineffectiveness of this inter-

mittent drainage system as a flushing agent for the surrounding area. Small patches of open water amid abundant marginal and aquatic vegetation typify this slough.

Fauna: *Physa* sp. *Lymnaea humilis. Gyraulus parvus.*

Location 7. Beaver Lake; E ½ portion of Sec. 21, E ½ portion Sec. 28, W ¼ portion Sec. 27 and NW ¼ Sec. 33, T. 134 N., R. 71 W., Logan County. Beaver Lake is a permanent lake at the eastern edge of the Coteau Slope district, north of the village of Burnstad. Willow and cottonwood trees border the lake at many places. Aquatic and marginal vegetation is plentiful. The bottom consists of a fetid muck. There is a striking similarity between the characteristics of the water of this lake with those of Lake Hoskins.

Fauna: *Physa* sp. *Lymnaea humilis. Lymnaea* sp. *Gyraulus parvus. Gyraulus* sp. *Helisoma trivolvis. H. anceps. Promenetus exacuous. Aplexa hypnorum. Armiger crista. Amnicola limosa. Valvata tricarinata. Pisidium* sp. Land snails: *Vallonia gracilicosta. Euconulus fulvus. Zonitoides arboreus. Pupillidae* spp.

Location 8. South Slough west of Napoleon; lying within Sections 13, 14, 23, 24, 25, 26, 35 and 36, T. 135 N., R. 73 W., Logan County. This slough was sampled by taking about ½ cu. ft. of sediments from along the highest strand line. The sediments between this point and open water were too soft to be traversed so that no water sample or thermal data was taken. The slough is in the Coteau Slope district. Marginal and aquatic vegetation abounds.

Fauna: *Physa* sp. *Lymnaea palustris. L. humilis. L. stagnalis. Gyraulus parvus. Gyraulus* sp. *Aplexa hypnorum. Promenteus exacuous. Armiger crista.*

Location 9. Lake Isabel; SE ⅓ portion Sec. 27, SW ¼ Sec. 26, N. ¾ portion Sec. 34, NW ¼ Sec. 35, T. 139 N., R. 72 W., Kidder County. Lake Isabel is one of several permanent lakes which lie along the buried course of the ancestral Cannonball River according to Rau and others (1962, p. 34, 35). The shape of the outwash body in which it is situated and the attenuated series of lakes of which it is the largest eastern member suggests it may have also been a depression in a major distributory channel draining the ice which deposited the Burnstad Drift. Lake Isabel is situated in the Coteau Slope district and is in the

Long Lake drainage system.

Lake Isabel is in outwash sediments. Rushes grow in large patches in the lake as well as along the shore. The strand line has beaches of medium to fine grain sized sand, but the bottom is covered with a foul mud.

Fauna: *Gyraulus parvus. Promenetus exacuous. Valvata tricarinata.*

Note: The sampling of this location was unproductive to such a marked degree that we regard it as faulty. Previous inspections of the shore line of this lake indicated that a more complex molluscan fauna exists. As no collections were made at the time, no evidence exists for the more complex fauna and, therefore, we do not report it here. The presence of *Valvata tricarinata,* an operculate, in the present collections is significant.

Location 10. Lake Josephine. SE 1/3 portion Sec. 26, NW 1/3 portion Sec. 25, SE 1/3 portion Sec. 24, NE 1/4 Sec. 35, T. 134 N., R. 74 W., and S 1/2 Sec. 19, T. 134 N., R. 73 W., Kidder County. Lake Josephine is a shallow permanent lake in the Missouri Coteau district. Aquatic and marginal vegetation is plentiful, to the point of giving the lake the character of a marsh.

Fauna: *Lymnaea palustris. L. humilis. Gyraulus parvus. Gyraulus* sp. *Helisoma trivolvis. Promenetus exacuous. Aplexa hypnorum. Armiger crista. Pisidium* sp.

Location 11. Slough; SE 1/4 Sec. 20, T. 143 N., R. 74 W., Kidder County. This location consists of a very small ephemeral slough which probably contains no water in a year of normal rainfall. It is approximately 150 ft. by 25 ft. in dimension. Tumbleweed balls filled the water which was only a foot or so deep. No water or bottom sample was taken. The Slough is situated in the Missouri Coteau district.

Fauna: *Lymnaea humilis. Gyraulus parvus.*

Location 12. Slough; Sec. 4 exclusive of the SW 1/4, S 1/2 Sec. 33, and the W 1/4 portion Sec. 3, T. 143 N., R. 74 W., Kidder County. This slough lacked the large amounts of marginal and aquatic vegetation typical of the others in the area. Its basin may be partially or wholly in bedrock (probably Pierre Shale). The beach was made up of a very uniform medium to coarse grain sized sand of shale fragments. The slough is situated in the Missouri Coteau district.

Fauna: *Physa* sp. *Lymnaea palustris. Gyraulus parvus. Gyrau-*

lus sp. *Promenetus exacuous. Pisidium* sp.

Location 13. Woodhouse Lake; E 1/3 portion Sec. 11, SW 1/4 Sec. 1, NW 1/4 Sec. 12, T. 144 N., R. 74 W., Kidder County, Most of Woodhouse Lake has more of the characteristics of a marsh than those of a lake. It is a permanent body of water and is situated in the Missouri Coteau district.

Fauna: *Lymnaea palustris. L. stagnalis. Gyraulus parvus. Helisoma trivolvis.*

Discussion

The ecologic data applies to the faunas reported, but should not be construed as necessarily typical for the bodies of water described. The summer of 1962 was one of the wettest on record for the state, the lakes were thermally unstratified when sampled and the sample density was inadequate to form the basis of generalities on the limnology of the various bodies of water. The information is presented to illuminate a set of conditions under which the mollusks reported can successfully exist.

There is no observable correlation between any of the chemical factors, or combinations thereof, reported here and the faunal diversity of water bodies or with the distribution of single species. Nitrates, nitrites, sulfates, oxygen, phosphorus, ammonia, etc., may be controlling factors. It is interesting to note that the operculate snails, *Valvata tricarinata* and *Amnicola limosa* occur in only two localities and that both of these are in the Coteau Slope district. One of these two localities, Beaver Lake, has the most complex molluscan community. As has been mentioned before, the Coteau Slope district is presumably a geomorphically older district than the Missouri Coteau. Beaver Lake, South Slough at Napoleon and Lake Isabel may have been in existence throughout the period of late Wisconsin glaciation which deposited the Burnstad drift.

The Burnstad drift contains numerous lake sediments which were deposited in ice-walled ponds in and on stagnant ice and contained faunas very similar to the fauna of Beaver Lake. *Amnicola* and *Valvata* dominate most of the Pleistocene faunas which have been studied. All of the species (except *Aplexa hypnorum*) which are now found on the Missouri Coteau and Coteau Slope districts were present in the Pleistocene faunas. The absence of operculates from the Missouri Coteau bodies of water,

if the present study proves to reflect the general situation, will necessitate explanation. LaRocque has suggested that faunal diversity is a function of the time required for mollusks to invade an area (in Kupsch, 1960). The faunas of Locations 7 and 8 seem to support his idea. The results of this study indicate that no single or combined grouping of the parameters evaluated explains the presence of operculates in two bodies of water and their absence from eleven others. The position of the lakes containing operculates in the Coteau Slope district and those lacking them in the Missouri Coteau district may prove to be mere coincidence as further studies are made. If correlation does not exist between water content and fauna and operculates are not found in the Missouri Coteau district, LaRoque's theory will be a tempting explanation for the distribution of mollusks in the area. However, much more work must be accomplished before any such conclusion is justified.

Acknowledgments. We wish to express our appreciation to Dr. James Underhill, of the Department of Zoology, The University of Minnesota for reading and commenting on the manuscript. His suggestions were of great help, but he is in no way responsible for the data or conclusions reported here.

Financial support for the field work was provided by the North Dakota Geological Survey.

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ADDITIONAL RECORDS FROM COCOS ISLAND

By WILLIAM K. EMERSON and WILLIAM E. OLD, JR.
American Museum of Natural History

During March and April, 1963, Dr. Paul Slud, Research Associate of the American Museum of Natural History, collected, incidental to his ornithological investigations, shells at Wafer Bay, Cocos Island. This oceanic island is situated approximately 325 miles southwest of Costa Rica at 5° 32′ 57″ north latitude and 86° 59′ 17″ west longitude.

Collections of mollusks from this isolated and uninhabited island are not common. Hertlein (1963), in a biogeographic study of the island, recorded 88 species of marine and brackish water species of mollusks, including 12 pelecypods, 61 gastropods, 4 chitons, and 11 cephalopods. The specific identity of 3 species was not determined and one record was thought to have been based on mislocalized locality data. According to Hertlein's tabulation, 88% of the species occur in the Panamic Province and 6% of the species apparently are endemic. Only 6% of the species are represented in the Indo-Pacific Province, in sharp contrast to Clipperton Island, where nearly 50% of the species have affinities with the Indo-Pacific fauna (Hertlein and Emerson, 1953).

The present collection is composed largely of badly worn, beach specimens. None of the gastropods or pelecypods was collected alive, and many of the gastropods show evidence of having been occupied by hermit crabs. This collection, however, is significant in that 12 of the 40 species collected were not known previously from Cocos Island. All the new records are species common to the Panamic Province with the exception of *Terebra maculata* (Linnaeus), which is an Indo-Pacific species, and *Cymatium pileare* (Linnaeus), which is tropicopolitan in distribution.

The species comprising Dr. Slud's collection are listed below, using the nomenclature of Hertlein (1963) for the previously reported taxons. New records for the island are prefaced by an asterisk (*). The collection is deposited in the American Museum of Natural History.

PELECYPODA

Arca (Anadara) grandis Broderip and Sowerby, 1 large valve.
Arca (Anadara) reinharti Lowe, 1 valve.
Isognomon quadrangularis (Reeve), 1 paired specimen.
**Ostrea iridescens* Hanley, 1 valve.
Ostrea palmula Carpenter, 1 valve.

GASTROPODA

Acanthina brevidentata (Wood), 2 specimens.
Acmaea (Nomaeopelta) mesoleuca Menke, 3 specimens.
**Bulla punctulata* A. Adams, 2 specimens.
Bursa caelata (Broderip), 1 specimen.
Cerithium adustum Kiener, 2 specimens.
Conus dalli Stearns, 2 specimens.
**Conus diadema* Sowerby, 3 specimens; previous records of *Conus brunneus* may be referable to this species.
**Conus purpurascens* Sowerby, 2 specimens.
Conus tiaratus Broderip, 1 specimen.
**Cymatium pileare* (Linnaeus), 1 specimen.
Cymatium vestitum (Hinds), 1 specimen.
**Cypraea albuginosa* Gray, 1 specimen.
Cypraea isabellamexicana Stearns, 1 specimen.
Cypraea moneta Linnaeus, 6 specimens.
Ellobium stagnalis (Orbigny), 4 specimens.
Hipponix grayanus Menke, 1 specimen.
Hipponix pilosus (Deshayes), 3 specimens.
Littorina aspera Philippi, 2 specimens.
Nerita funiculata Menke, 1 specimen.
Nerita ornata Sowerby, 2 specimens.
Neritina latissima Broderip and form *pilsbryi* Tryon, 5 specimens.
**Oliva* cf. *O. spicata* (Röding), 1 specimen.
Planaxis planicostatum Sowerby, 6 specimens.
Purpura patula pansa Gould, 1 specimen.
**Semicassis centiquadrata* (Valenciennes), 1 specimen.
Siphonaria gigas Sowerby and form *characteristica* Reeve, 3 specimens.
**Terebra* cf. *T. maculata* (Linnaeus), 3 juvenile specimens, *fide* G D. Hanna and L. G. Hertlein.
**Turritella* sp. indet., 1 badly worn specimen.
Thais columellaris (Lamarck), 3 specimens.

Thais haemastoma biserialis (Blainville), 1 specimen.
Thais (Vasula) melones (Duclos), 10 specimens.
**Thais planospira* (Lamarck), 3 specimens.
Thais speciosa (Valenciennes), 1 specimen.
Thais triangularis (Blainville), 1 specimen.

AMPHINEURA

Chiton (Chiton) stokesii Broderip, 11 live-taken specimens and many single valves.

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LACK OF SHELL-ATTACHED PELECYPODS IN ARCTIC AND ANTARCTIC WATERS

BY DAVID NICOL
Department of Geology, Southern Illinois University, Carbondale, Illinois

In the frigid waters of both the arctic and the antarctic regions, no pelecypods attach themselves to the bottom by cementing the shell to solid objects as do the ostreids and the chamids. Pelecypods of the frigid waters of these regions that are members of the epifauna attach themselves by their byssi or may lie on the bottom on one valve (pleurothetic habit). Shell-attached pelecypods are rare in deep water (more than 1829 meters or 1000 fathoms), and only 3 species in Clarke's annotated list of abyssal mollusks have this habit out of a total of 402 species of pelecypods recorded. One of the species listed is an *Anomia* which attaches by a calcified byssus and is thus not in the true sense attached by shell material of one of the valves. The other two abyssal species which attach by cementation of one of the valves are *Pycnodonte cochlear* and *Hinnites pusio.*

Shell-attached forms do live in cold water, as for example, *Hinnites gigantea* in the Gulf of Alaska and *Crassostrea virginica* in the Gulf of St. Lawrence; but the majority of bivalve genera which attach themselves to the substrate by shell cementation during part of or all their lives are wholly confined to warm water or are poorly represented in cooler water, as for example *Spondylus, Chama, Echinochama, Plicatula,* and *Cleidothaerus.* It is interesting to note also that the shell-attached fresh-water

naiades are confined to warm water, mainly in Africa, South America, and India.

What possible explanations are there for the lack of shell-attached species in the arctic and antarctic regions and their scarcity in deep water, which is, of course, cold water, and also in cold shallow water? There seem to be two main contributing causes. Most shell-attached pelecypods have thick shells and most frigid-water pelecypods have thin shells, and the lack of sufficient shell material may be one factor in the scarcity of shell-attached bivalves in frigid or cold water (less than 10° C). This, however, cannot be the only factor involved. One other consideration is the uncommonness of epifaunal pelecypods in cold water. For example, ice periodically scraping the bottom in shallow areas would prevent shell-attached pelecypods from anchoring to solid objects there. The relative scarcity of the proper physical environment in regions having frigid water would certainly be another factor. However, the writer is not completely satisfied that these two reasons alone would explain the complete lack of shell-attached pelecypods in the present-day arctic and antarctic regions.

This short note is part of a study of antarctic pelecypods which is supported by a research grant from the National Science Foundation (G1-3335).

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MOLLUSCA FROM EAST TAVAPUTS PLATEAU, GRAND COUNTY, UTAH

BY ERNEST J. ROSCOE AND GORDON GROSSCUP
Chicago Natural History Museum and
Anthropology Department, University of Utah

Introduction. While engaged in archaeological survey and excavations near the Youth Camp of the Uintah* and the Ouray Ute Tribe at the invitation of the Ute Business Council, the junior author took the opportunity to make incidental collections

* Spelling of Uintah for the county and tribe, and Uinta for the mountains, river, and valley. follows usage set by the U. S. Geological Survey and the U. S. Geographic Board.

of mollusks during the summers of 1961 and 1962. These specimens were submitted to the senior author for identification in August 1963. The paucity of data on the molluscan fauna of this region makes it desirable to place these identifications on record. Specimens are deposited in the collection of the Zoology Department, University of Utah and in the junior author's collection.

Location and General Features. The Tavaputs Plateau forms the southern lip of the Uinta Basin, a section of the Colorado Plateaus physiographic province (Fenneman, 1931). Ranging in elevation from about 7000 to 9000 feet, the Tavaputs descends some 3000 to 4000 feet to the Canyon Lands section to the south by two giant steps designated the Roan and Book Cliffs. The Roan Cliffs are an eastward extension of the Pink Cliffs of the High Plateaus section to the southwest, the most spectacular features of which are Cedar Breaks and Bryce Canyon. The molluscan fauna of the Cedar Breaks area has been reported by Gregg (1941). The Roan and Book cliffs are distinct in the western part of the Tavaputs but tend to merge eastward. The Tavaputs as a whole is divided into an east and west member by the Green River. U. S. Highway 50 skirts the southern margin of the cliffs, while the Basin itself is traversed in its northern portion by U. S. Highway 40. The Tavaputs is accessible only from highway 40 via secondary roads. The material reported herein was obtained from five stations located near the head of Hill Creek, T. 17 & 18 S., R. 19 E., in Grand County, about sixty miles south of Ouray, Uintah County. Hill Creek flows northward, merges with Willow Creek and empties into the Green River a few miles downstream from the confluences of the White and Duchesne rivers with the Green river near Ouray. The general area is readily located on most road maps of the State.

Previous work. As an outgrowth of its paleontological interest in the region the Carnegie Museum has done extensive work on the biota of the Uinta Basin and adjacent Uinta mountains. Only a portion of the molluscan material collected by the Carnegie Museum has been reported to date, mostly from the northern portion of the Basin (Brooks, 1935, 1936). The report by Graham (1937) on the plants of the region includes a resume of the geography and geology of the entire Basin.

Environment of the Collection Stations. The following remarks

are abstracted from field notes by the junior author. The East Tavaputs Plateau is highly dissected. All of the rock exposures in the area are of a yellowish sandstone, presumably part of the Eocene Green River formation. According to Graham (1937) the soils of this area have a pH of between 6 and 7. During July and August the days are pleasantly warm; the nights are quite chilly. Heavy, but brief, rainstorms are frequent, particularly in August. Snowfall is heavy in the winter and may begin in September or October and last into May or June.

In the upper Hill Creek area (stations 1-4) the forest cover includes aspen, spruce, pine and fir. The valley floors and other open areas are grassy, with interspersed stands of sagebrush. Juniper and scrub oak occur sparingly. Deer are abundant, and elk, bear, badger and porcupine also occur. Beaver have been introduced. Animal bone recovered from archaeological deposits in a small cave in Jennie Canyon included deer, mountain sheep and porcupine. All of the stations in this area lie within 100 to 200 feet of the 8000 foot elevation marker at the Weaver Reservoir dam located near the head of the east fork. The Ute Youth Camp is located at the head of the west fork of Hill Creek.

Florence Creek (station 5) heads to the west of Hill Creek and flows through a deep canyon almost directly west to its junction with the Green River. The collection station was about seven miles upstream from the mouth of the canyon at an elevation of between 6000 and 7000 feet. The vegetation here included pine but no spruce or aspen. Mountain mahogany grows on the slope at the head of the canyon and elderberry was noted in the canyon itself.

All specimens collected were of terrestrial gastropods and were collected alive unless otherwise noted. A number of springs and several branches of Hill Creek and Weaver Reservoir were examined for aquatic mollusks but none were found.

Collection Stations and Mollusks Obtained

Sta. 1. East fork of Hill Creek, east side of valley near Weaver Reservoir dam, Sec. 13, T. 18 S., R. 19 E. El. about 8025 feet. Specimens collected at base and trunk of aspen trees, Aug. 7, 1961. *Oreohelix eurekensis* Henderson and Daniels; *Oreohelix subrudis* (Pfeiffer); *Pupilla blandi* Morse.

Sta. 2. West fork of Hill Creek on east slope of Steer Ridge and just above Ute Youth Camp, Sec. 10, T. 18S, R. 19 E. El. about 8000 feet. Specimens collected on dead leaves at base and

on trunk of aspen, Aug. 4, 1961, and July 10, 16, 29, 1962. *Oreohelix eurekensis* Henderson and Daniels; *Oreohelix subrudis* (Pfeiffer); *Oreohelix* sp. indet., juv., probably *subrudis; Pupilla blandi* Morse; *Vallonia albula* Sterki; *Vitrina alaskana* Dall; *Zonitoides arboreus* (Say).

Sta. 3. West fork of Hill Creek between Jennie Canyon and the next (unnamed) canyon to the north (downstream from Sta. 2), Sec. 3, T. 18 S., R. 19 E. July 27, 1962. A single empty shell of a badly weathered *Oreohelix* found floating in the creek. Probably *O. subrudis* (Pfr.).

Sta. 4. West side of the north fork of Burnt Draw near the mouth of the fork, Sec. 27 or 34, T. 17 S., R. 19 E. Specimen collected in humus at base of aspen, July 27, 1962. *Oreohelix subrudis* (Pfeiffer), young.

Sta. 5. Florence Creek Canyon, near head of one branch of canyon along trail which enters Florence Creek Canyon from Post Canyon, Sec. 18?, T. 17 S., R. 19 E. El. between 6000 and 7000 feet. July 29, 1962. Empty shells of an apparently stunted form of *Oreohelix subrudis* (Pfeiffer).

Remarks. Oreohelix eurekensis Henderson and Daniels, here recorded from the Tavaputs Plateau at stations 1 and 2, was described from specimens from the north side of Godiva Mountains near Eureka, Juab County in the Bonneville drainage basin. The species has not been found outside of the type locality except in the Deep Creek Mountains near the Utah-Nevada border (Roscoe, 1954). A subspecies, *O. e. uinta,* was described in 1939 by Brooks from specimens obtained at Hominy Creek near Whiterocks, Uintah County. The senior author has grave doubts as to the validity of this subspecies, being distinguished primarily on the basis of its relatively wider umbilicus, an exceedingly variable feature in the oreohelices. The Tavaputs specimens cannot be distinguished from the typical *eurekensis,* although the younger individuals have the basal sculpture like those of *uinta* as illustrated by Pilsbry (1939, fig. 348). Type specimens of *uinta* have not been examined but it is suggested that these may be subadult individuals of *eurekensis.* The species is undoubtedly widely distributed over both the Bonneville and Colorado drainages in favorable situations. A close relative, *O. handi* Pilsbry and Ferris, replaces it in Nevada, and *O. californica* Berry, is apparently a related form in California.

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ON RHYTIDOTHYRA JACOBSONI ALCALDE

By MORRIS K. JACOBSON

In 1948 (p. 4) Alcalde described *Rhytidothyra jacobsoni* from the Sierra San Carlos near Luis Lazo, Pinar del Río Province, Cuba. This shell has never been figured. The purpose of this paper is to provide a figure and to clarify the difference of this species from its only congener, *R. bilabiata* (Orbigny). In addition a number of notes are added. A translation of the original Spanish description follows:

"Shell ovate and semiobese, varying in size in accordance with sex, color yellow-orange on the last whorls and reddish on the postnuclear whorls, peristome reddish, polished; nuclear whorls unknown since all specimens collected were decollated; the postnuclear whorls well rounded and marked with a fine axial sculpture, regular and closely set, and a less prominent spiral sculpture having a corded appearance; in the last four whorls of the shell the intersection of both types of sculpture form prominent nodules that give a semi-spinose appearance to the shell; this characteristic is most noticeable in the ultimate and penultimate whorls; umbilicus well marked with both types of sculpture, the axial sculpture markedly entering into it; suture well marked and half hidden by the extremities of the axial sculpture which is strong, doubled, and prominent in this area; peristome bilabiate as is characteristic of the genus; operculum typical. Dimensions of the type: Alt. 22.5, width 18 mm."

It should be noted that the color of most specimens is very much subdued, giving way to a general drabness of appearance. As far as the sexual variation of size is concerned, this is very noticeable, the male being distinctly the smaller shell. This fact was not noted by Torre and Bartsch (1941) in the related *R. bilabiata.*

The easily observable and unmistakable difference lies in the

nodulate or corded appearance of the axial ribs, caused by the intersections with the spiral sculpture. In typical *bilabiata* the spiral ribs, when present, lie lower than the axial ribs, and hence, as Torre and Bartsch noted, do not form conspicuous nodules (1941, p. 219). These nodules are apparent to the naked eye and readily visible under low magnification. The axial ribs become wavy and long at the sutures, filling them much more effectively than in *bilabiata*. There is in addition a pronounced difference in the outlines of the shells of the two species, *jacobsoni* being much more ovate than the generally turrited *bilabiata*.

The genus *Rhytidothyra* was erected by Henderson and Bartsch (1920, p. 65) on the basis of the peculiar device used for breathing and the distinctive design of the operculum. There is no reason to doubt that these characteristics form a strong support for generic distinction.

Rhytidothyra jacobsoni seems to occupy a narrow salient along the southeast slope of the Sierra San Carlos. This mountain range lies to the south of the Pinar del Rio-Guane highway and runs in a southwest direction from the town of Luis Lazo. I have specimens from the following localities: Hoyo de la Guataca (type locality), Ensenada del Palmar, and Ensenada de la Cruz del Muerto, all being indentations along the steep slope of the Sierra. The entire range of the species as far as we could determine stretches for about 2 miles.

Torre and Bartsch (1941) described 5 subspecies of *R. bilabiata*. Though their validity remains to be established, it might be worthy of note that I frequently found more than one of these subspecies in a single locality.

The type specimen of *jacobsoni,* which used to be in the collection of Alcalde, is now in the newly organized Academia de Ciencias de Cuba, housed in the former capitol building in Havana.

Until the superb figures by Torre and Bartsch were published, no accurate figure of *R. bilabiata* was available. Orbigny's figure (1842) for an unknown reason is colored green (pl. 22, figs. 3, 4, 5). The sculpture shows axial and transverse striae of equal strength. As Arango and Torre and Bartsch noted, figs. 8 and 8′ are illustrations of the operculum of this species and not of *Cyclostoma pudica* (sic) as Orbigny stated. Arango is right in assigning Reeve's shell (1863, pl. 9, fig. 71, not fig. 31 as in

Arango, nor fig. 7 as in Torre and Bartsch) to *Chondropoma violaceum* Pfeiffer. Surprisingly, Torre and Bartsch (1941, p. 221) still listed Reeve's incorrect reference in the synonymy of *bilabiata* Orbigny. Aside from the unique color pattern of Reeve's figure, the pear-shaped aperture in no way represents the circular aperture so characteristic of *Rhytidothyra*. Pfeiffer's figure (1846, pl. 43, fig. 31-32) is quite obviously not the shell described by Orbigny, thus confirming the doubts Pfeiffer himself expressed (p. 317). The description (p. 316) and the figure seem to refer to some form of *Chondropoma pictum* (Pfeiffer), 1839. The figure in Zilch (1960, fig. 1449), adapted from Reeve, is unrecognizable.

I wish to express my gratitude to the American Museum of Natural History in New York and to John Ernest Jacobson for providing the illustrations that accompany this paper; to Dr. William K. Emerson for reading the manuscript and giving valuable suggestions; and to Mr. William Old for aiding in the hunting down of tricky biographical references.

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RECORDS AND TWO NEW SPECIES, STENOTREMA ABADDONA AND S. GLASSI, FROM OKLAHOMA

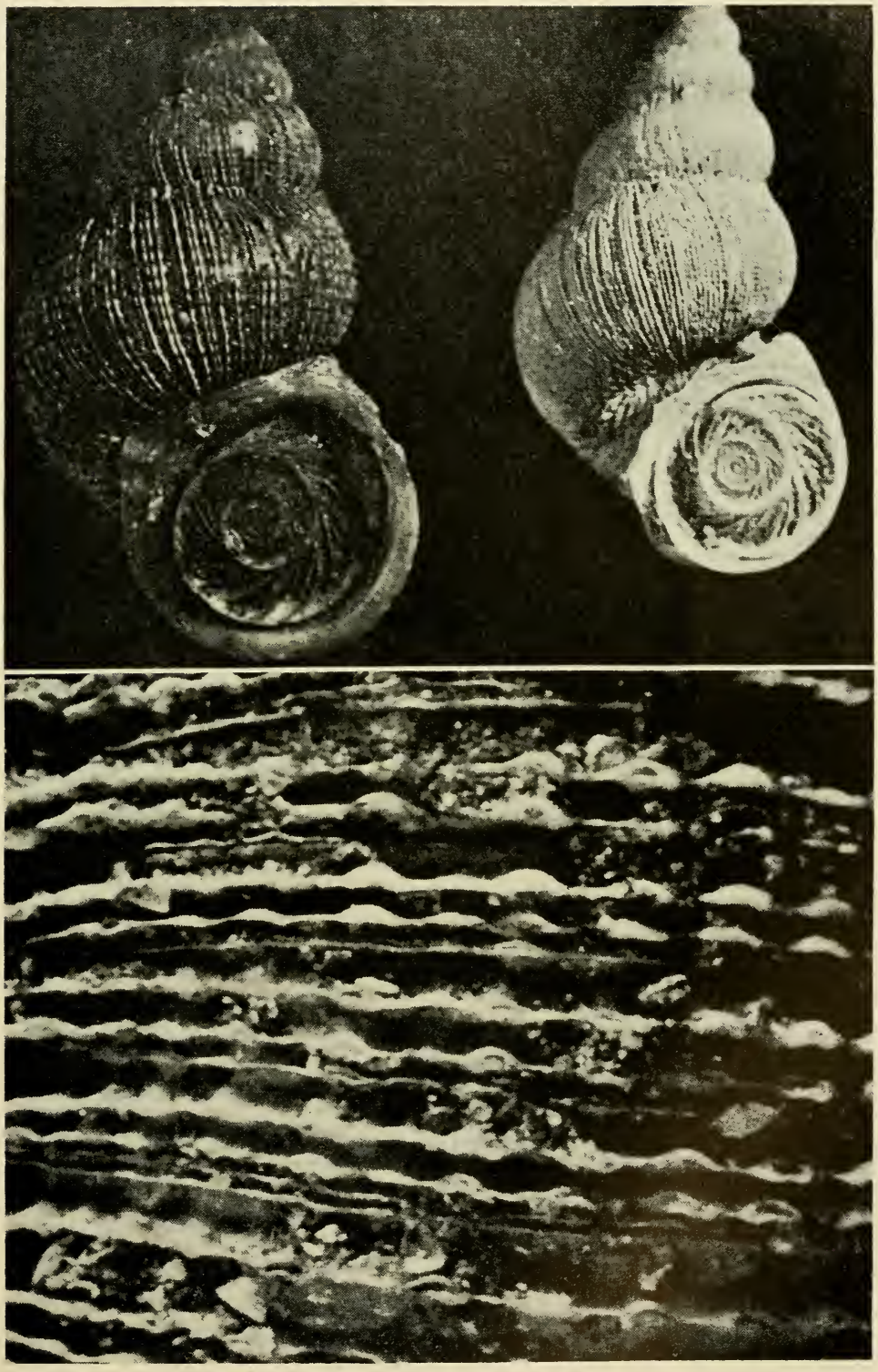
By BRANLEY A. BRANSON
Department of Biology, Kansas State College, Pittsburg

STENOTREMA GLASSI, new species. Figure 1 d, e, f

Type Locality: A well-shaded limestone and sandstone hillside, near east rim of Lake Tenkiller Dam, Tenkiller State Park, Sequoyah County, Oklahoma. Collected on 24:VIII:1963.

Description of holotype: (Acad. Nat. Sci. Philadelphia 290010). Nuclear whorls nearly smooth, strongly everted; remaining whorls with short, prostrate periostracal hairs; periphery moderately angular; apex depressed-conical; base convex; sutures lightly impressed; aperture long, its interdenticular sinus broad and relatively shallow; edge of basal lip slightly raised proximally and free for its entire length, the groove behind it progressively deeper toward the upper insertion; callosity of basal lip demarked by only a slight groove, notches or teeth completely lacking; buttress of parietal tooth very strongly developed and raised slightly away from parietal wall; parietal tooth moderately high, highest near its point of entrance into aperture, then abruptly diminishes in height and is directed sharply into the aperture, appearing truncated and short in a basal view, the descending arm not being visible; length of aperture 7.5 mm.; greatest width of aperture 4.5 mm.; diameter of shell 11.5 mm.; height of shell 6.5 mm.; 5¼ whorls. Named in honor of my good friend Dr. Bryan P. Glass, Department of Zoology, Oklahoma State University.

Stenotrema glassi is most closely related to *S. labrosum* from which it differs in several respects. The aperture is longer and broader in *glassi* than in *labrosum,* 48 specimens taken with the holotype averaging 6.78 mm. (6.5-7.0) for apertural length and 3.84 mm. (3.5-4.0) for width. The basal lip edge is less adnate in *glassi* and the groove behind the lip much deeper. In *labrosum* the parietal tooth forms a rather even curve where it is directed into the aperture whereas in *glassi* it is abruptly curved, the descending arm being hidden in the latter species but at least partially visible in the former. The lack of a notch in the basal lip of *glassi* and its presence in *labrosum* is another salient difference. The sutures of *labrosum* are considerably deeper and the whorls less elevated than in *glassi;* the embryonic whorls of *labrosum* possess the typical *Stenotrema* granular striae whereas these are nearly lacking in *glassi.*



Rhytidothyra jacobsoni Alcalde

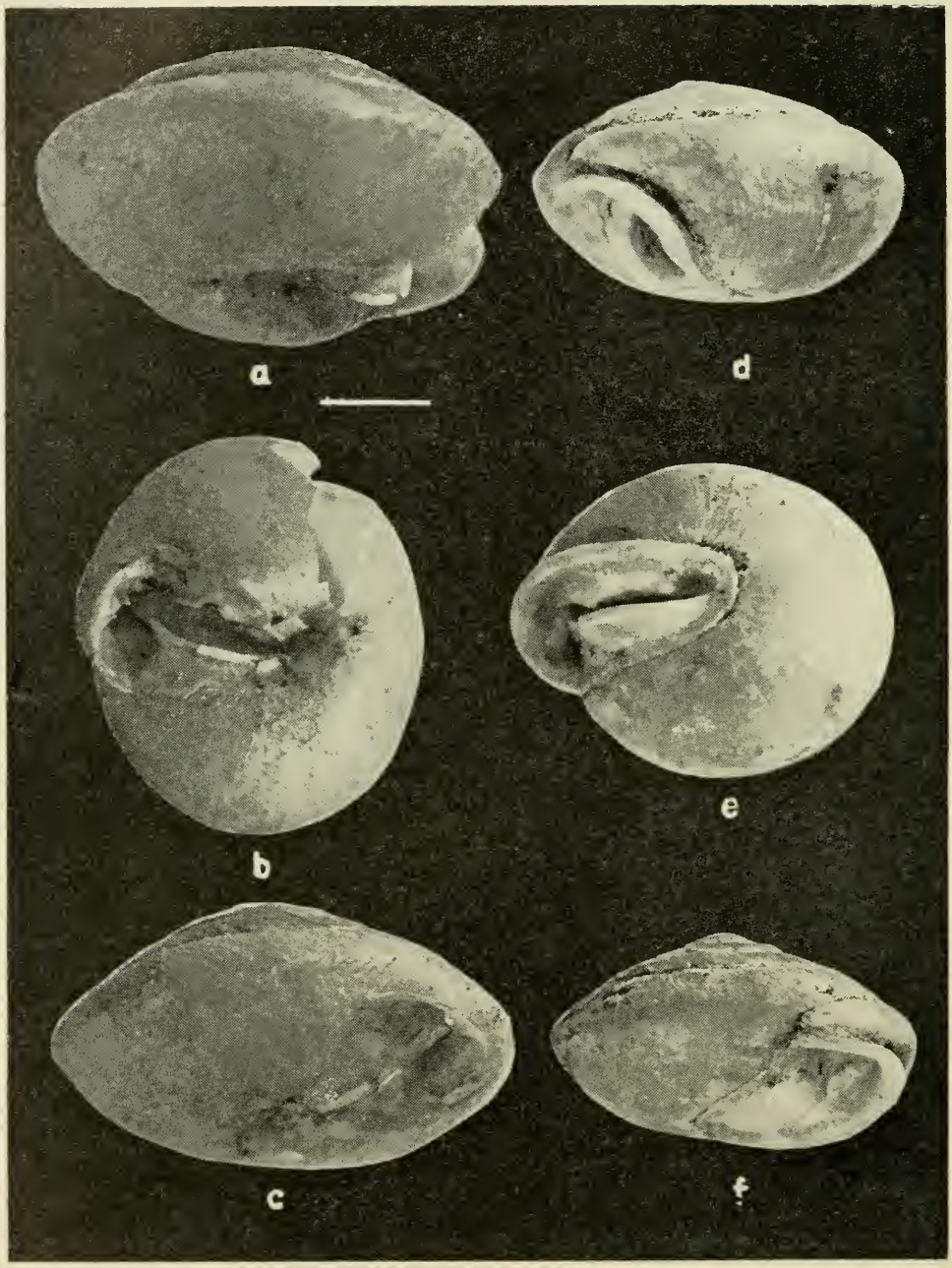


Figure 1.—a, b, c, *Stenotrema abaddona* sp. nov.; d, e, f, *Stenotrema glassi* sp. nov. Scale line equals 2.0 mm.

STENOTREMA ABADDONA, new species. Figure 1 a, b, c

Type Locality: A well-shaded, talus-laden hillside overlooking a small, unnamed creek, easternmost arm of Lake Tenkiller, Tenkiller State Park, Sequoyah County, Oklahoma. Collected on 24:VIII:1963.

Description of holotype (A.N.S.P. 290011). Light yellowish-cinnamon in color, nearly transparent; first one and two-thirds whorls strongly everted and marked by closely-set, transverse granular striae; remaining whorls with small transverse ridges beset with short, stiff and tapering, nearly to quite prostrate periostracal hairs, all directed peripherad; hairs above sutures and at the acute periphery longest, about 0.5 mm. in length, double at periphery; base moderately convex, with numerous short, spiral ridges bearing minute prostrate hairs, the latter lying in the same plane as ridges; imperforate but base deeply impressed over umbilical region; parietal tooth completely lacks a buttress; columellar origin of basal lip begins in the impressed, well-like base, arches strongly outward, then becomes pinched inward to produce a very deep and broad interdenticular sinus; inner edge of basal lip rounded and very narrow, not being demarked from rest of lip by a groove; notch of basal lip located in outer one-half, small, but broadly u-shaped; outer edge of basal lip strongly adnate for nearly its entire length, being free only where it angles upward around periphery, then becomes adnate again; upper insertion of outer lip bears a small tubercle a short distance within near the parietal wall; parietal tooth low and thin, barely reaching level of basal lip, strongly arched and highest near middle, then is directed into the moderately capacious distal portion of aperture where it ends a short distance within; rest of aperture slightly wider than basal lip; shell cracked behind aperture by photographer.

Corroborative description. The first paratype (Kansas State College 7708), taken with the holotype, has a parietal tooth which is slightly hooked and which does not completely penetrate into the aperture because of the very deep interdenticular sinus. Paratype two (University of Michigan 215712), taken alive, has a somewhat more conical apex than the holotype. The foot is narrow and nearly black; the mantle is marked by black dashes. It was collected on 21:VIII:1963 from the shaded side of Miamichi Mountain, one-eighth of a mile west on the Kiamichi Tower Road from its junction with Highway 259, LeFlore County, Oklahoma. The third paratype (Kansas State College 7826) was found in a locality with conditions similar to those prevailing at the type locality, 5.5 miles east of Salina, on High-

way 82, Mayes County, Oklahoma; 25:VIII:1963. The two paratypes listed as number four (Kansas State College 7911), two immature shells and two dead shells with their apices broken, were collected from a shaded, limestone-strewn hillside overlooking Spavinaw Creek, Spavinaw, Mayes County, Oklahoma; 25:VIII:1963. The second shell of the fourth paratypes has a higher spire than any of the others and nearly lacks the basal lip notch. The immature form has an exceedingly fine knife-edge acute periphery, low growth striae and impressed, very fine spiral lines. The fifth paratype (Kansas State College 7915) was found on a steep, heavily shaded and moist hillside, one mile south of Lanagin, McDonald County, Missouri; 26:VIII:1963.

Measurements:

	Diameter	Height	Whorls
Holotype	11.0 mm.	6.1 mm.	5½
Paratype 1	11.0 mm.	6.5 mm.	5¼
Paratype 2	11.0 mm.	6.0 mm.	5¼
Paratype 3	9.7 mm.	5.6 mm.	4⅞
Paratype 4	10.6 mm.	6.0 mm.	5¼
	10.5 mm.	6.5 mm.	5¼
Paratype 5	10.8 mm.	5.0 mm.	5¼

Stenotrema abaddona (specific epithet from *Abaddon,* "the pit of Hell," referring to the deeply impressed basal region) is considered to be most closely related to *S. evardsi* (Bland) from which it differs in having a much more deeply impressed axis and a more strongly adnate basal lip, the latter being free for over one-half of its length in *evardsi*. The new species also differs in having a wider notch in the basal lip and a very broad and deep interdenticular sinus. The two species are similar in having relatively narrow apertures and parietal teeth which turn abruptly into the aperture; the periostracal hair arrangement is also similar.

STENOTREMA UNCIFERUM (Pilsbry).

On 20:VIII:1963 a single living specimen of this interesting little polygrid was collected from deep leaf litter on Rich Mountain, 5.6 miles east of Page, on Highway 59, LeFlore County, Oklahoma. The shell (Kansas State College 7840) measures 8.5 mm. in diameter, 6.4 mm. in height and has slightly more than five whorls. The basal lip is strongly arched and the projection

from the outer end of the parietal tooth is completely detached. This new record, and the two species described above, brings the total number of *Stenotrema* known from Oklahoma to eight.

Mesodon clenchi (Rehder).

Two freshly dead shells, taken from the limestone bluffs surrounding the Darby Boyscout Camp, Cherokee County, Oklahoma on 24:V:1963, represent another addition to the known molluscan fauna of Oklahoma. One of these shells has the faint indications of a parietal tooth and both have moderately angulated peripheries; the umbilicus is partially closed in both. The measurements for these specimens (Kansas State College 7932) are:

Diameter	Height	Whorls
23.5 mm.	11.0 mm.	5
23.0 mm.	11.5 mm.	5½

NOTES AND NEWS

Corbicula fluminea in Florida.—The ocurrence of the introduced Asiatic clam, *Corbicula fluminea* (Müller) into the western United States has been well documented, and it has been recorded from the Tennessee River (Sinclair and Ingram, 1961, Naut., *74:* 114-118), the Ohio River (Fechtner, 1962, Naut., *75:* 126), and several Gulf drainages in Louisiana (Dundee and Walter, 1963, Naut., *77:* 30) and Alabama (Hubricht, 1963, Naut., *77:* 31) east of the Rocky Mountains. Recent collections of fresh-water mollusks from the Florida Panhandle and Peninsula have disclosed the presence of *C. fluminea* in these areas as well.

On May 20, 1963, *C. fluminea* was collected in abundance from the Apalachicola River at U. S. Hwy. 90, ½ mi. west of Chattahoochee, Gadsden County, Florida. This clam was not present at this same station (¼ mi. below the Jim Woodruff Dam) when visited by Clench and Turner in 1953 (1956, Bull. Fla. State Mus., Biol. Sci., *1:* 97-239). Hence, the introduction of *C. fluminea* into this southern drainage system occurred within the past decade.

Further collecting was undertaken in the Apalachicola drainage system in an attempt to determine the range of *C. fluminea.*

Several localities above the Jim Woodruff Dam at Chattahoochee were examined: (1) Lake Seminole at Jim Woodruff State Park, Jackson County, Florida, (2) Lake Seminole at Florida Hwy. 2 (= Georgia Hwy. 91), Jackson County, Florida, (3) Chattahoochee River at U. S. Hwy. 84, Houston County, Alabama, (4) Spring Creek at Reynoldsville, Seminole County, Georgia, (5) Flint River at Bainbridge, Decatur County, Georgia, and (6) Lake Seminole at Jim Woodruff Dam Project, Decatur County, Georgia. One additional site below the Jim Woodruff Dam was visited: Apalachicola River at Florida Hwy. 20, ½ mi. west of Bristol, Liberty County Florida. *Corbicula fluminea* was found to be absent above the dam, but present below it at both stations.

The Chattahoochee station specimens were generally larger (length of largest 33.0, height 30.5, width 20.6 mm.) and more abundant than those of the Bristol station (largest l. 23.0, h. 22.3, w. 15.7 mm.). The substrate at Chattahoochee consisted of sand and gravel, while the Bristol substrate was composed of sand and clay. The Apalachicola River is characterized by high turbidity and a general lack of aquatic vegetation. *Corbicula fluminea* was collected from the Chattahoochee station with one gastropod, *Campeloma geniculum* (Conrad), 15 species of unionid clams including *Crenodonta neisleri* (Lea), *Elliptio crassidens incrassatus* (Lea), *Lampsilis anodontoides floridensis* (Lea), and *Quincuncina infucata* (Conrad) in considerable quantity, and two sphaeriid clams: *Sphaerium lacustre* (Müller) and *Eupera cubensis* (Prime).

On August 10, 1963, *C. fluminea* was collected in astounding quantity from the Withlacoochee River (not the Withlacoochee River which is a tributary of the Suwannee River) at the south edge of Inglis, U. S. Hwys. 19 and 98, Levy County, Florida, a stream 200 miles southeast of the Apalachicola River. This locality is 3 miles below the dam at the lower end of the Florida Power Corporation Reservoir. The presence or absence of *C. fluminea* above the dam has not yet been determined. However, to note that so many sites, in which *C. fluminea* is found flourishing, are below such power dams is of interest. Probably the absence of silting at these sites is favorable for their existence, while silting in the impoundments may preclude these clams immediately above the dam.

In contrast to the Chattahoochee and Bristol stations, the Withlacoochee River was not turbid, and its substrate consisted of fine sand. Only rare individuals of one snail *Goniobasis floridensis* (Reeve), and one unionid clam, *Elliptio strigosus* (Lea), were found associated with *C. fluminea.*

Corbicula fluminea from the Withlacoochee station varies in size, shape, and coloration from the populations in the Apalachicola stations. The Withlacoochie animals (largest l. 28.3, h. 25.1, w. 17.9 mm.) are smaller than those of the Chattahoochee station but larger than those of the Bristol station. Shells from the Apalachicola River are generally more inflated, have more prominent beaks, and appear more triangular in outline than do the Withlacoochee shells. In addition Apalachicolan shells are of a dark brown color over the beaks and a horn-yellow color over the peripheral half of the valves, while the Withlacoochee shells are uniformly dark brown. There was no evidence of growth annuli in any of the specimens.—William H. Heard, Florida State University, Tallahassee.

Limax maximus and Ferrissia meekiana in Oklahoma.—While attempting to find an intermediate host for *Nematobothrium,* in conjunction with parasitological research at the University of Oklahoma Biological Station, Dr. Lewis Peters discovered a very large colony of limpets on 24 July, 1962, living in Lake Oberlin. This is a very muddy and shallow oxbow of the Red River, located in the southeastern corner of Bryan County, Oklahoma. Although several hundred specimens were collected, only 27 were kept for records. Eight of these are *Ferrissia meekiana* (Stimpson); the remaining 19 are all *Laevapex fusca* (Adams). Heretofore, *"Gundlachia"* has not been found living in Oklahoma. Branson, Taylor and Taylor (in press) reported fossils of this species from south-central Oklahoma, as did Taylor (1960) from southwestern Kansas. The only records of living *F. meekiana* near Oklahoma are those of Leonard (1959) from east-central Kansas. The specimens range from 2.0 x 1.0 mm. to 2.5 x 1.6 mm. in size; 6 of them are septate.

The habitat from which these two limpets were secured is usual for both (Basch, 1959). However, *L. fusca,* recently reported from Oklahoma (Branson, 1961), is sometimes found in streams with a moderate current. Two of the *Laevapex* were in-

fected with ophthalmoxiphidio-cercariae, as determined by Peters. This record brings the total of ancylid species known from Oklahoma to 5.

On 22 July, 1962, Branson discovered 3 large specimens, 110.0 to 118.0 mm. when fully extended, of *Limax maximus* Linnaeus in a water meter cover at Miami, Ottawa County, Oklahoma. This species likewise has not been reported heretofore from Oklahoma. Leonard (1959) recorded it for nearby Kansas. This record brings the total for slugs known from Oklahoma to 12.—Branley A. Branson, Kansas State College, Pittsburg and Lewis Peters, Northern Michigan College, Marquette.

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Striatura meridionalis in Michigan. — In May, 1961, *Striatura meridionalis* (Pilsbry and Ferriss) was found in leaf mould from a moist, shaded glen on the wooded east side of "Mt. Rosy" sand dune, five miles south of Grand Haven, Ottawa Co., Michigan. The dune region on the eastern shore of Lake Michigan is florally peculiar, for it contains several species of plants found elsewhere only along the Atlantic Coast. Perhaps this floral peculiarity has some bearing upon the occurrence of this species at this locality. Other snails found with it have been found elsewhere in southern Michigan. This is the first record for this species from the state of Michigan, and the northernmost record to date. I am indebted to Miss B. A. Wilson, of the Entomology Department of Michigan State University, for her assistance in collecting at this locality.—F. Wayne Grimm.

Otala lactea In Virginia, Texas, and California.—In 1961 and 1962, I found *Otala lactea* (Müll.) on wasteground in 4 places. In Virginia, a single weathered shell was found in an overgrown garden at Ocean Park, Princess Anne Co. A search on similar ground both in this town and in nearby Norfolk failed to produce additional specimens. In Texas, specimens were hibernating on *Amaryllis* leaves in a vacant lot near the Freue-

THE NAUTILUS

Vol. 77 April, 1964 No. 4

A NEW SPECIES OF SINUM FROM THE GULF OF CALIFORNIA

By JOHN Q. and ROSE L. BURCH

Authors writing on the Panamic fauna have generally accepted *Sigaretus concavus* Lamarck, 1822=*Sinum concavum* (Lamarck, 1822) with *Sigaretus grayi* G. P. Deshayes in Lamarck, 1843=*Sinum grayi* (Deshayes, 1843) in synonymy. This species is known from Chile and Peru. Our opinion is that the form from the Gulf of California is another species.

SINUM CORTEZI, new species. Pl. 5, figs. 1 & 3

Shell fawn-colored, globosely ear-shaped; spirally striate with epidermis of rust color; whorls slopingly ventricose, spirally ridged, with narrow interstices; spire light color.

Type locality: Shrimp trawlers working between Mazatlan and Altata in 15 fathoms.

Holotype: deposited in California Academy of Sciences, San Francisco (Dept. Geology, Type Coll. no. 12601).

Sinum concavum (Lamarck, 1822) from Chile and Peru (Pl. 5, figs. 2 & 4) consistently has an interior of a deep glossy chestnut-brown, whereas that of the form from the Gulf of California is nearly white with growth lines showing light and dark through the shell. The apex of the South American form is uniformly dark, whereas that of the Gulf form is light. The concentric sculpture on the South American shells is broader and more even on the body whorl, and is much more evenly colored. The umbilicus of the Gulf of California shells is more open, and mature shells are heavier and thicker.

There are 30 paratypes of which two are in the collection of Dr. Bruce Campbell, one in the collection of Dr. Homer King, some will be retained in the Burch collection, and others distributed to institutions. We are indebted to Mr. Allyn G. Smith and Dr. Leo. G. Hertlein of the California Academy of Sciences of San Francisco for their advice.

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THE GENUS AGARONIA J. E. GRAY, 1839

By JOHN Q. and ROSE L. BURCH

We should consider the extent to which we are justified in generic separations based solely on the radula. It is well known that Johannes Thiele and others thought it to be conclusive. However, to do so, at least in the Olividae, would seem to place species together that would leave the paleontologist and others incredulous when they must depend upon the morphologic characters of the shell alone. It is a question as to which causes more difficulty, two species with very similar shell characters that are shown to be very different, or two species with very different shell characters that are shown to be very much alike.

Thiele and many others have placed *Agaronia* as a subgenus of *Olivancillaria*. The genus *Agaronia* J. E. Gray, 1839 has priority over *Olivancillaria* Orbigny, 1840. If either is to be made a subgenus of the other, the genus should be *Agaronia*. *Agaronia* J. E. Gray, 1839, Zoology of Captain Bechey's Voyage, p. 131; type, monotypy, *Oliva hiatula* Lamarck=*Oliva hiatula* (Gmelin).

Sherborn in Index Animalium, 1929, gave the date of the genus *Olivancillaria* A. Orbigny as 1841, but later Sherborn and Griffin in the Annals and the Magazine of Natural History, series 10, vol. *13*, 1934, gave us another version. In this article the authors stated that they had examined a complete set of Orbigny's Voyage dans l'Amerique Meridionale with the dates on the original wrappers. In the volume on "Mollusques," the genus name *Olivancillaria* occurs on page 420. Two species are discussed, *Olivancillaria brasiliensis* on page 420, not illustrated, and *Olivancillaria auricularia* on page 421, pl. 59, figs. 20-22. According to Sherborn and Griffin, the livrasion containing pages 409-424 bears the date 1840. As far as we have been able to ascertain, *Olivancillaria* dates from 1840. *O. auricularia* is cited on plate 59, but the "O" undoubtedly refers to *Oliva* which accompanies the preceding species. This plate was dated in

1839 and may be the basis of the 1839 date given to *Olivancillaria* by Fischer, Thiele, Wenz et al. We think the correct date to be 1840.

Olivancillaria Orbigny, 1840, Voyage dans l'Amerique Meridionale; type, *Oliva brasiliensis* Chemnitz, 1788=*Oliva brasiliana* Lamarck, 1811 = *Porphyria urceus* Röding, 1798 = *Agaronia (Olivancillaria) urceus* (Röding, 1798). It is our opinion that *Olivancillaria* Orbigny, 1840, may be recognized as a subgenus of *Agaronia* J. E. Gray, 1839. The species *urceus* Röding is unquestionably prior to the Lamarckian *brasiliana*. Deshayes in the second edition of Lamarck's Histoire cited the same figures for the Lamarckian species that are given as the basis of the Röding name. No 50-year rule can possibly save the Lamarckian name. The Röding name has been frequently used by modern authors. It is interesting that Dillwyn, 1817, recognized the identity of Lamarck's form with the *brasiliensis* Chemnitz, but he tried to resurrect a still earlier name from the Portland Catalogue, *Voluta pinguis,* p. 174, lot. 3740. Fortunately this is a nomen nudum and can be ignored. Röding placed all in his genus *Porphyria* which falls into the synonymy of *Oliva* Bruguière, 1789. *Porphyria urceus* Röding, 1798, Museum Boltenianum, p. 37, sp. 457.

We have two basic types of radula to consider here. In *Oliva*, the radular ribbon shows but little variation. Differences between species are small. The rachidian tooth is tricuspidate. *Oliva porphyria* (Linnaeus) is the type of the genus *Oliva* Bruguière, 1789. (p. 6, fig. 3, pl. 7, fig. 10). While the rachidian teeth of both *Agaronia* and *Olivancillaria* are tricuspidate, there are small denticles on the sides that are not present in *Oliva*. The radular teeth of both are very similar in this character.

A study of *Agaronia* is very perplexing. Our common Panamic-Pacific species is extremely variable with several shell forms in a single colony. Quite possibly there is but a single good species in the Panamic-Pacific region. The species *Agaronia testacea* (Lamarck, 1811) certainly ranges from the head of the Gulf of California southward on the Pacific coast to Panama, and seems to be very common along the Caribbean coast of Central America. The first reference we have to these is an article in Nautilus *19* (2), 18, 1905 by W. H. Fluck. Fluck mentions that his shells were identified by Pilsbry, Johnson, Dall, etc. Mr. A. A. Olsson

has also given numerous Carribbean localities for the species. The species *Agaronia travassosi* Lange de Morretes, 1938 from Brazil is amazingly like the west Mexican *Agaronia testacea* (Lamarck), and two other species from Brazil remind one of *Agaronia murrha* Berry of the Central American coast. They are *Agaronia lanei* Lange de Morretes, 1938, and the recently described *Agaronia langei* Zanardini, 1960. *Agaronia acuminata* (Lamarck, 1811) is a distinct west African species. Nickles, 1950 accepts the species *annotata* Marrat, 1871 from the same fauna as distinct. Tryon and many others have placed it in the synonymy of *Agaronia acuminata* (Lamarck). In this we concur. *Agaronia lutraria* (Röding, 1798), p. 34, sp. 421, with *Agaronia subulata* (Lamarck, 1811) in synonymy, is a species from Indonesia. It was placed in the synonymy of the west African *Agaronia acuminata* (Lamarck, 1811) by Tryon, 1883, but in our opinion it is quite distinct. Reeve in Conch. Icon., 1850, figures it well. H. C. Weinkauff, 1878, separated the two species. *Agaronia gibbosa* (Born, 1778) is a common large species from the Indian Ocean. We are placing the species *nebulosa* Lamarck, 1811 in synonymy.

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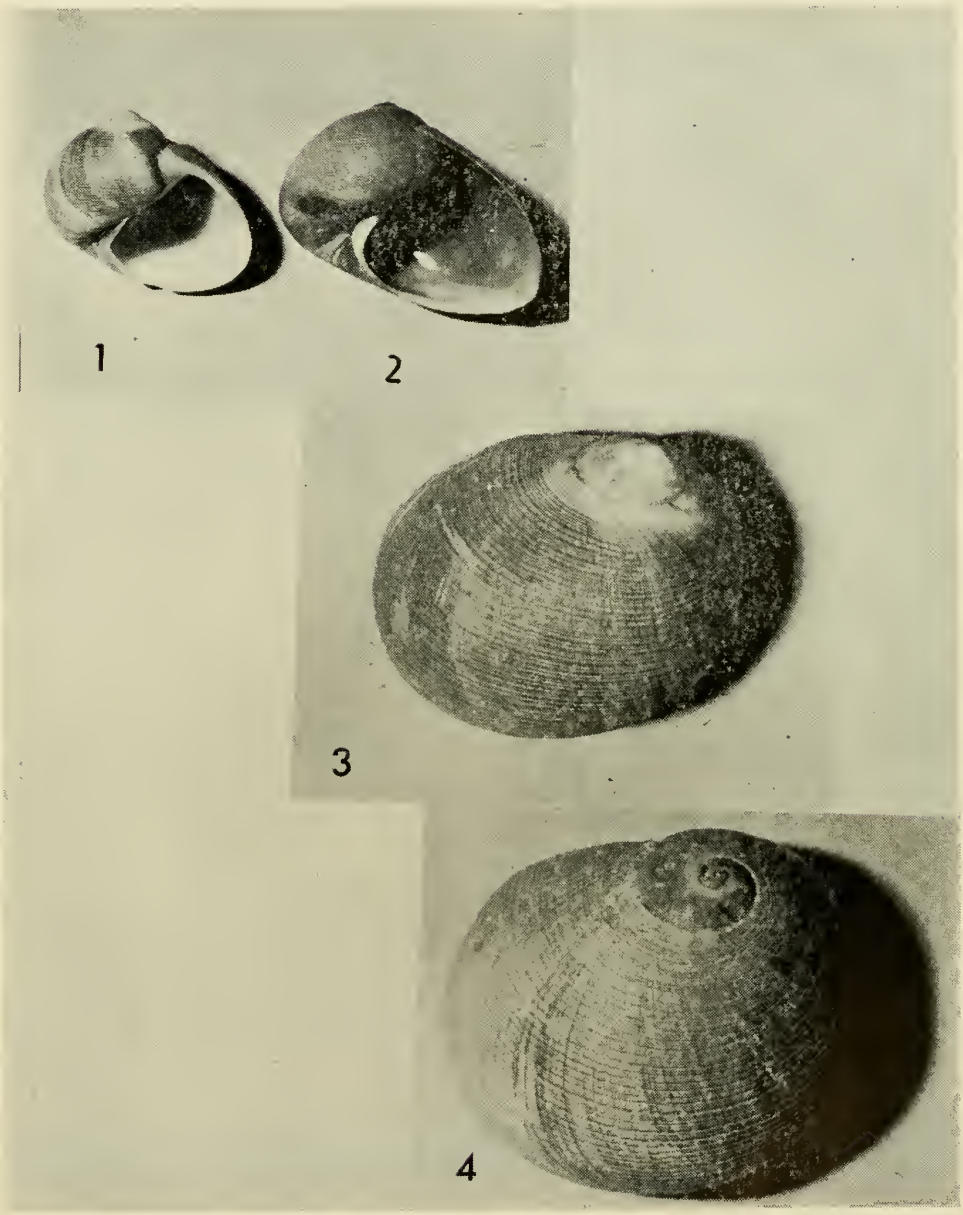
IDENTIFICATION OF HELIX STEURSIANA

By J. B. HENRARD
Oegstgeest, The Netherlands

This *Helix* was described by Shuttleworth in 1852. He received a specimen from Mr. Steurs, at that time governor of Amboyna (Moluccas), and named it after the donor. His description is very exact, but no figure was given. Pfeiffer copied the description in



Figs. 1 & 3. Holotype of *Sinum cortezi* Burch & Burch. 43.9 mm. Figs. 2 & 4. Hypotype of *S. concavum* (Lamarck) from Peru. 51.8 mm. Photographs by Allyn G. Smith.

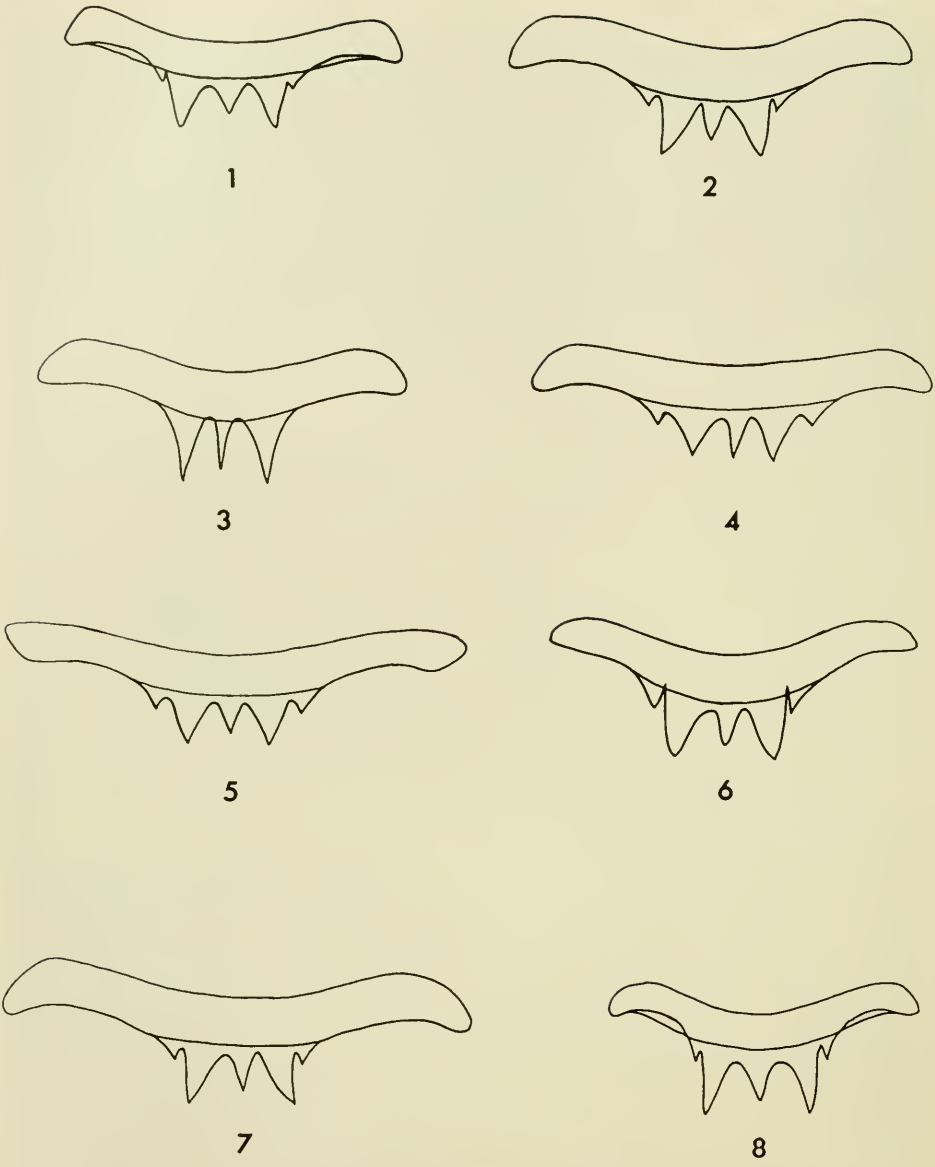


Fig. 1. *Agaronia travassosi* Lange de Morretes, 1938. Fig. 2. *A. (Olivancillaria) urceus* (Roding, 1798). Fig. 3. *Oliva porphyria* (Linnaeus, 1758). Fig. 4. *Agaronia (Olivancillaria) contortuplicate* (Reeve, 1850). Fig. 5. *A. acuminata* (Lamarck, 1811). Fig. 6. *A. (Olivancillaria) auricularia* (Lamarck, 1811). Fig. 7. *A. gibbosa* (Born, 1778). Fig. 8. *A. testacea* (Lamarck, 1811).

1859, Mon. Hel. Viv. *3*: 179. Martens, who investigated the Moluccas so thoroughly, says in Preuss. Exped., 1867, that many species from that region were seen by him only in the collections of amateurs, and that certainly they did not occur in the Moluc-

cas. He could not affirm that *Helix steursiana* and others were inhabitants of that area (loc. cit.: 324).

Dr. Pilsbry, Man. Conch. (2) : 7: 33, gave an exact translation of the original description and, with his great sagacity, recognized that Shuttleworth's species was a member of the genus *Papuina*, and placed it in his "6th group of *H. pileolus*." In 1961, Naut. 75: I divided this group into more homogeneous ones, and *Papuina steursiana* evidently belongs in the "group of *P. ferussaci*."

Because all the species of my group are endemic on the west coast of New Guinea, I was more and more convinced that *P. steursiana* also was an inhabitant of that region. However, *P. hedleyi* E. A. Smith, 1892, J. of Conch. 7: 72, was another species of this group. Smith's exact description, but without figure, was based on a single specimen, found in the British Museum without locality. However, since he recognized that it was allied closely to *Papuina exsultans* (Tapp.) and *P. ferussaci* (Lesson), he probably accepted it also as a species from New Guinea.

If Pilsbry's translated description of *P. steursiana* be compared, character by character, with that of Smith's, both specimens do agree in height (30 mm.) but *P. steursiana* is somewhat larger. Also the shells differ in 3 very striking characters. The most important of these is the subcolumellar tooth in *P. steursiana,* although none is mentioned in Smith's description. Secondly, *P. steursiana* is unicolor, while *P. hedleyi* has a small cinnamon zone beneath the suture and a castaneous base. Last but not least, the margin of the peristome is castaneous in *P. hedleyi,* but rosy in *P. steursiana.*

Later, Smith, 1897, Ann. Mag. Nat. Hist. (6) *20*: 413, in an article on the land shells of New Guinea, gave many new data on *P. hedleyi,* and listed as synonym, *P. canefriana* "Dohrn, Ms." Kobelt, 1894, Conch. Cab., ed. 2: 708, pl. 202, fig. 1, ans. 2. Very important is the fact that he indicated the great color variation in his species, and that all specimens appear to have a white, tooth-like prominence or thickening on the columella On p. 414, Smith adds: "Other specimens (var. *concolor,* nov.) are of a uniform whitish color beneath the pale greenish-yellow or ochraceous periostracum, and the peristome is margined with pinkish purple-brown or purple-black." Such specimens from

Kapaur also, precisely agree with Shuttleworth's description of the peristome in *P. steursiana.*

Finally, the great variability of *P. hedleyi* is discussed by C. K. Gude, 1910, Proc. Malac. Soc. London *9*: 83, who had extensive collections at his disposal from Hamatawarea near Fak-Fak, a locality south of the Gulf of McCluer. His specimens ranged from pale ochraceous to buff and dark, almost blackish brown; some of the paler shells had a pale base and pinkish peristome, while others had a pale base with a dark brown, narrowly margined peristome and another had the base blackish brown and a correspondingly dark, broadly margined peristome. However all dark specimens had a dark base. Important is Gude's statement that the columella always has a more or less prominent, whitish thickening, which in some bears a tooth or tubercle. Gude stated that the species had been recorded only from southwest New Guinea, but it also occurs north of the Gulf. I have examples from Inanawatan, called Negri Besar (Great Hinterland), collected by Mrs. T. van der Stoep-Frouwer and from Sorong (loc. Malami), found by my friend Paul Stelleman. Also on the large island Salawati, I fortunately discovered a population, which contained one living albino, with a totally white peristome. On the smaller nearby islands, which probably were connected formerly with Salawati, all the specimens seen by me were albinos.

My conclusion is that there are no differences between *Papuina steursiana* and *P. hedleyi concolor,* and that *P. hedleyi,* 1892, is a junior synonym of *P. steursiana,* 1852.

Iredale, 1941, proposed a genus *Zetomina* with *Papuina hedleyi* as type, but, at that time, he had insufficient knowledge of Pilsbry's 6th group. For the time being, I prefer Pilsbry's opinion that the formation of a number of groups for *Papuina* species seems a better plan, that anatomical characters afford good clues to these minor groups, and that the establishment of "sections" is practically impossible. Smith's opinion, that *P. hedleyi* was most nearly related to *P. ferussaci,* is not acceptable. His species with its concave profile differs conspicuously from the 3 other species in the group of *P. ferussaci.*

UNIONIDAE OF RED CEDAR RIVER, MICHIGAN

By KENNETH J. BOSS
U. S. Fish and Wildlife Service, Washington, D. C.

The major objectives of this note are to document more fully the distribution of 14 species of unionids in the Red Cedar River, to indicate some areas of pollution, and to provide a record of faunal changes since the report of van der Schalie (1940).

The Red Cedar River is a tributary stream of the Grand River in western Michigan. Its main channel is nearly 50 miles in length and its total drainage area, including its three main tributaries, is approximately 355 square miles. The bottom types are variable, but the lower portions of the stream are gravel or rock while the upper are predominantly sand. The minimum discharge flow (July, 1931) was 3 cubic feet per second while the maximum (April, 1946) was 5,510 cubic feet per second; therefore, the depth at any one station in the river varies according to the amount of precipitation and evaporation. The river is slightly alkaline and highly buffered and in some areas the oxygen content is above 90% saturation (Brehmer, 1956).

During the fall of 1958, a series of collecting stations along the river was sampled for the unionid fauna. Five general areas may be delimited:

1. At East Lansing, Ingham County. Here 4 stations were made, all upstream from the local sewage treatment facilities. The bottom type was predominantly gravel.
2. At Okemos, Ingham County. This area included five stations in the vicinity of Okemos; the substrates were gravel, sand and mud.
3. At Williamston, Ingham County. Three stations were made in this area; bottom types included gravel, sand and mud with some local concentrations of silt.
4. At Webberville, Ingham County. The three stations here were made in sand and gravel substrates.
5. At Fowlerville, Livingston County. Soft clay and mud substrates were typical of the two stations in this area.

The following is a list of the species with numbers, designating the areas in which specimens were collected. Most of the specific names are modeled after Clarke and Berg (1959).

Elliptio dilatatus (Rafinesque), 1, 2, 3, 4.
Fusconaia flava (Rafinesque), 1, 2, 3, 5.
Pleurobema cordatum (Rafinesque), 1, 2, 3.

Anodonta grandis (Say), 1, 2, 3, 4, 5.
Lasmigona compressa (Lea), 4, 5.
Lasmigona costata (Rafinesque), 1, 2, 3.
Anodontoides ferussacianus (Lea), 1, 2, 3, 4, 5.
Strophitus undulatus (Say), 1, 2, 3, 4, 5.
Alasmidonta calceolus (Lea), 2.
Alasmidonta marginata (Say), 2, 3.
Villosa iris (Lea), 2.
Lampsilis radiata siliquoidea (Barnes), 1, 3, 4, 5.
Lampsilis ovata ventricosa (Barnes), 1, 2, 3, 4.
Actinonaias ellipsiformis (Lea), 1, 2.

The most common species was *Elliptio dilatatus* while *Fusconaia flava, Anodonta grandis, Strophitus undulatus* and *Lampsilis ovata ventricosa* were moderately common and the most widely distributed. *Villosa iris, Actinonaias ellipsiformis, Lasmigona compressa* and *Alasmidonta calceolus* were rare. When a comparison of these observations with those of van der Schalie (1940) is made, a decrease in the abundance of *Villosa iris, Actinonaias ellipsiformis* and *Alasmidonta calceolus* is evident while an increase in the abundance of *Anodonta grandis, Lasmigona costata* and *Alasmidonta marginata* is obvious. The stream is entirely devoid of unios immediately downstream from Fowlerville and East Lansing; industrial and sewage effluents have rendered the conditions unsuitable for the maintenance of the unio fauna in these areas.

The author is indebted to Dr. T. W. Porter for his guidance and help in the field; to Dr. H. van der Schalie, who kindly advised on the identification of some species; and to Mr. R. I. Johnson, who checked some aspects of the nomenclature.

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NOTES ON AMERICAN MELAMPIDAE

By J. P. E. MORRISON[1]

The earliest name for this family based on a genus in use is Melampidae of Stimpson, 1851 (Shells of New England, p. 51). Subfamily names based on *Melampus* were used by Pfeiffer (Zeit. für Malakozool. *10*: 8: 1853) and by H. & A. Adams (Proc. Zool. Soc. London 1854: 30: Jan., 1855) before the name Ellobiidae was validated. Pfeiffer in August 1854 (Malak. Blatt. *1*: 146) mentioned the names Ellobiidae and Ellobiinae from H. & A. Adams' manuscript, but did not include the genus name *Ellobium,* and did not adopt either of these names. The family name Ellobiidae was first published by H. & A. Adams in their "Genera" (*2*: 236: Sept., 1855).

Pfeiffer continued to use the subfamily name Melampea in his Auriculacea Monographs of 1856 and 1876. H. & A. Adams in 1855 (Genera 2: 242), and Pease in 1871 (Proc. Zool. Soc. London 1871: 450) used the name Melampinae. Odhner in 1925 (Arkiv för Zool. *17A* (6): 14) and Morrison in 1951 (Amer. Malac. Union Annual Report for 1950: 8) used Melampodinae for the subfamily. There is no question of a *nomen oblitum;* the earliest subfamily name in current use should be used for the family name also.

In my opinion, the "Studies on the Genus *Melampus*" by Holle and Dineen (Nautilus *73* (1): 28-35: July 1959; and *73* (2): 46-51: Oct. 1959) are confusing and incomplete. In the part of the "genus" studied by Holle and Dineen I recognize 4 generic groups under their three "species." The groups studied by Holle and Dineen should be labelled, even if considered only subgenera or sections, since their names have been in existence for many years. I cannot agree that these four groups, represented by four biologically separate species, recognizable on shell characters alone, can be given only three species names.

Holle and Dineen studied 4 species:

1) *Melampus (Melampus) coffeus* (Linnaeus). This is the genotype of *Melampus;* it is known from only the southern half of Florida, and from Central America and the West Indies, southward to Colombia, Suriname, and Brazil. It was figured on plate 5, figure 1, and plate 6, figure 4, by Holle and

[1] Published by permission of the Secretary of the Smithsonian Institute.

Dineen.

2) *Melampus (Micromelampus) bidentatus* Say. This species ranges from southern Quebec (north shore of the Baie de Chaleur) southward all the way to Texas and into the West Indies. It was figured on plate 5, fig. 2, and plate 6, figs. 5 and 6, by Holle and Dineen.
3) *Detracia floridana* (Pfeiffer). This smaller species lives on Atlantic United States shores only, from New Jersey (Delaware Bay) to New Orleans, Louisiana. Holle and Dineen figured it on plate 5, fig. 3.
4) *Pira monile* (Bruguière). This species is known from southern Florida across the West Indies to South America. It is the "group C," the *"Melampus flavus"* of Holle and Dineen.

Apparently Holle and Dineen did not read the Nautilus *71* (4), p. 124, where I pointed out the fact that all known Texas *Melampus* belong to the species *M. bidentatus* Say. I repeat here the generic group sculpture characters I listed in 1958, by means of which every specimen of *Melampus, Micromelampus,* and *Pira* may be correctly identified. Words inserted at this time are bracketed.

"The distinction of *Melampus* [*(Melampus)*] *coffeus* [(Linnaeus)] from *M.* [*(Micromelampus)*] *bidentatus* [*Say*] and from *Pira monile* [(Bruguière)] is easily made, because the sculpture of the shell above the shoulder of the body-whorl is different in each case. *M.* [*(Micromelampus)*] *bidentatus* possesses spiral incised lines on this part of the shell (if not all the way up and down the body-whorl). *M.* [*(Melampus)*] *coffeus* has no such spiral incised lines on the spire or the upper part of the body-whorl. *Pira monile,* on the other hand, shows a single spiral row of epidermal setae, or pit-scars after loss of the setae, in the middle of each whorl on the spire."

In my opinion, these are generic groups of the Melampidae, because on coasts other than the western Atlantic shores of America, the same groups are represented by other species which possess correspondingly identical sculpture characters on the shells. For example, the Indo-Pacific species include:

Melampus (Melampus) flavus (Gmelin) 1791,
Melampus (Micromelampus) nucleolus Martens 1865,
Detracia pulchella (Petit) 1842, and
Pira fasciata (Deshayes) 1830.

The name *Pira monile* (Bruguière), 1789, must be used for the "group C" of Holle and Dineen, for two reasons: First, it was

published two years ahead of Gmelin's *flava,* and secondly, the name *flava* does not concern the same species. *"Melampus flavus"* of authors generally, has been a confused mixture of at least 3 American species. As a matter of fact, this name does not belong to any American species. *Voluta flava* of Gmelin, 1791 (Syst. Nat., 13th edn., p. 3436), and of Dillwyn, 1817 (Descr. Cat., I, p. 506), are both based solely on Martini-Chemnitz, Conch. Cab., Vol. *2,* p. 126, pl. 43, fig. 444, published in 1771. Examination of the non-binomial work of Martini-Chemnitz shows a poorly colored figure, and a text that says this is the "Golden Shell" of the East Indies. In other words, *Melampus (Melampus) flavus* (Gmelin), 1791, is the earliest and only correct name for the Indo-Pacific species later named *Melampus luteus* by Quoy and Gaimard in 1833.

The generic name *Pira* is still in need of a valid type designation. The currently accepted designation by Kobelt 1880 (Ill. Conchylienbuch, *2:*303) is technically invalid because the name *fasciata* Deshayes was not one of the originally included specific names. I hereby designate as the genotype of *Pira: Tralia (Pira) kusteri* ("Krauss" in) Kuster 1844 = *Pira fasciata* (Deshayes) 1830. By the designation of one of the originally included names that is known to be a synonym of the species *Pira fasciata* (Deshayes), the generic name *Pira* will remain with the group for which it has been used, on the very few occasions it has been recognized and appeared in print.

ASIATIC CLAMS AT PARKER, ARIZONA

By WILLIAM MARCUS INGRAM, LOWELL KEUP, and CROSWELL HENDERSON*

The Asiatic clam, *Corbicula fluminea* (Müller), has infested the irrigation system on the Colorado Indian Reservation for the second time in little more than a year. Collections made by Public Health Service biologists evidence the great rapidity with which this clam can repopulate an area. This second infestation necessitates removal of the clams and other detritus from portions of the irrigation system.

The clams were present when the Bureau of Reclamation last cleaned the cement-lined canals of the system in January 1962.

* Biologists. Division of Water Supply and Pollution Control. U.S. Public Health Service.

Large populations of the clam were found 16 months later in May 1963. After learning of the reinfestation, Public Health Service biologists collected samples May 23, 1963, from the "Main Canal" at a bridge crossing 4 miles southwest of Parker, Arizona, on the Parker-Ehrenberg Highway. Their sampling indicated a population of from 135 to 275 clams per square foot of canal bottom in heavy gravel, sand, and decomposing organics. The decomposing organics were primarily dead *Cladophora* buried in sand and compacted by roots of abundant growths of a rooted pond weed, *Potamogeton spp.* and the algae, *Chara spp.* and *Cladophora spp.* Associated animals were physid snails, dragonflies, planarians, simulids, and tendipedids. The remarkable population growth in the cleaned irrigation canal shows that the clams can rapidly repopulate an area. The closest source of clams for the canal is the Colorado River. Asiatic clams have previously been reported infesting the Colorado River intake of the Metropolitan Water District of Southern California's aqueduct (Ingram, 1959). More recently, the clams have been reported to be relatively abundant and widely distributed in the lower Colorado River from Parker Dam to the Mexican border.[1] Asiatic clams have also been found in irrigation canals in Phoenix (Dundee and Dundee, 1958).

Rapid dispersion and population growths have also been reported in the Eastern United States. The clam was first reported in the Tennessee River in 1959 (Sinclair and Ingram, 1961). The clam extended its range slightly in the Tennessee River during the next few years (Sinclair and Isom, 1961). Within a short time, the clam was found at various places along the Ohio River: Metropolis, Illinois (Fechtner, 1962); Dayton, Kentucky (Stein, 1962); and from Cincinnati, Ohio, to Warsaw, Kentucky (Keup, Horning, and Ingram, 1963). During this period, Bates (1962) also reported it in the lower Green River, a tributary of the Ohio.

The methods of dispersal remain open to speculation. Several hypotheses have been advanced. In the construction of cement locks, dams, docks, bulkheads, etc., in navigable waterways gravel is used as aggregate. Gravel may be dredged from river gravel bars, loaded on barges, and transported hundreds of miles to the construction site. Clams present in these gravels could be lost

[1] Manuscript; Henderson, C. and A. D. Sidio.

through spillage during transport or at the construction site. The clams could survive in the moist underlayers of gravel, or even for some period in dry gravel. The senior author has kept Asiatic clams alive out of water for a minimum of five days after which time they were discarded. Ingram (1941) has also reported that another small clam, *Pisidium abditum* Haldeman, survives when left on lake shores during drawdown periods.

Another hypothesis was forwarded to the senior author by Dr. William J. Clench, Curator of Mollusks, Harvard University, during a recent personal conversation. Dr. Clench suggested that clams resistant to desiccation may "hitch-hike" a ride on waterfowl; or possibly a tightly closed clam swallowed by a duck could survive the action of the gizzard and digestive juices, pass through the duck's digestive tract and thus be deposited in a waterway different from its origin.

Another logical hypothesis for distribution would be the transporting and eventual discarding of the clams by tourists, by fishermen who may have collected them as bait, or by aquarium hobbyists. These hardy clams do well in aquaria. Sinclair and Ingram (1961) surmised that Asiatic clams could have been introduced into the United States as aquaria contents that were later dumped into suitable waterways.

Three different size-classes were apparent in the clams collected at Parker, Arizona, with 30% ranging in size (anterior-posterior length) from 3 to 7 mm., 65% from 9 to 18 mm., and 5% from 22 to 28 mm. Ohio River clams exhibited approximately the same three size-classes (Keup, Horning, and Ingram, 1963). These 3 size-classes probably represent "year-classes." The 3-year-old clams at Parker, Arizona, indicate that some clams remained in the canal after it was cleaned in January 1962, or that clams at least 1 year old gained entry to the canal after it was cleaned. The remaining or introduced clams would have formed a nucleus for repopulation of the canal. The lack of a fourth-size class in neither the Ohio River nor the Arizona canal perhaps indicates that the clams rarely live longer than 3 years, or that the clams grow very little after their third year, which does not allow ready recognition of older groups based on size-class distribution.

The Asiatic clam has been receiving increased attention in the United States. The writers are not unmindful of the fact that

many more "inquisitive eyes" are looking into American waterways today than in the 1940s; therefore extended fresh-water mollusk distributions are bound to be discovered. Interest in the Asiatic clam will probably make its discovery in new areas of the United States more rapid. Since this clam creates nuisance conditions in canals, ditches, pumps, and cooling systems (Ingram, 1956; Ingram and Bartsch, 1960), distribution records are more likely to be published. The Public Health Service has received a number of requests for advice on control of the mussel in Western water systems. Recently problems have also been reported in its Eastern range.[2] Increased demand for its control will undoubtedly stimulate more investigations into the clam's life history, ecology, and physiology.

The writers wish to thank the personnel of the Land Operations Office, Bureau of Indian Affairs, Colorado River Agency, United States Department of the Interior who extended every courtesy to enhance our clam collections.

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[2] Manuscript; Thomas, N. A. and K. M. Mackenthum.

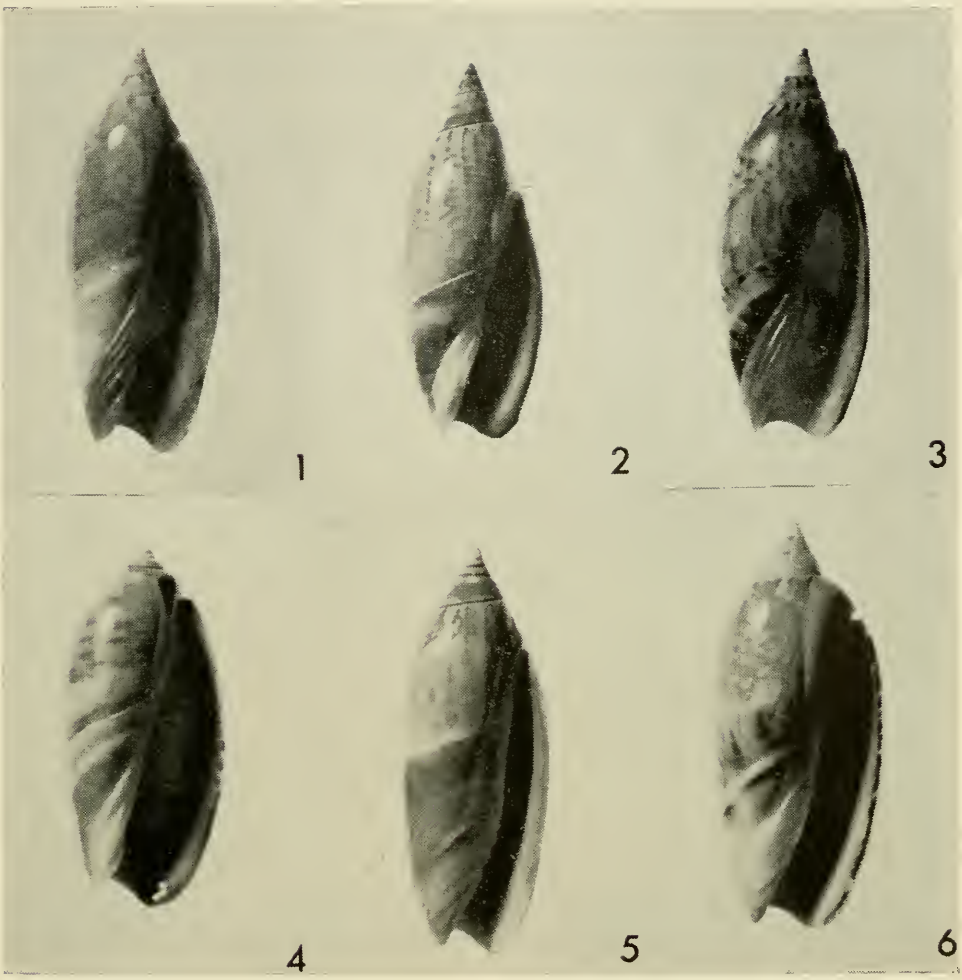

Fig. 1. *Agaronia hiatula* (Gmelin, 1791). Liberia, West Africa. Hypotype. Type species of *Agaronia* J. E. Gray, 1839. Fig. 2. *A. testacea* (Lamarck, 1811). Hypotype from Guaymas, Sonora, Mexico. Fig. 3. *A. travassosi* Lange de Morretes, 1938. Hypotype trawled 5 miles off Punta de Justinga, Rio de Janeiro state, Brazil, in 25 fathoms. Fig. 4. *A. murrha* Berry, 1953. Hypotype from Acapulco, Mexico. Fig. 5. *A acuminata* (Lamarck, 1811). Hypotype from Louanda, Angola, West Africa. Fig. 6. *A. gibbosa* (Born, 1778). Hyptotype from Pucket, Thailand.

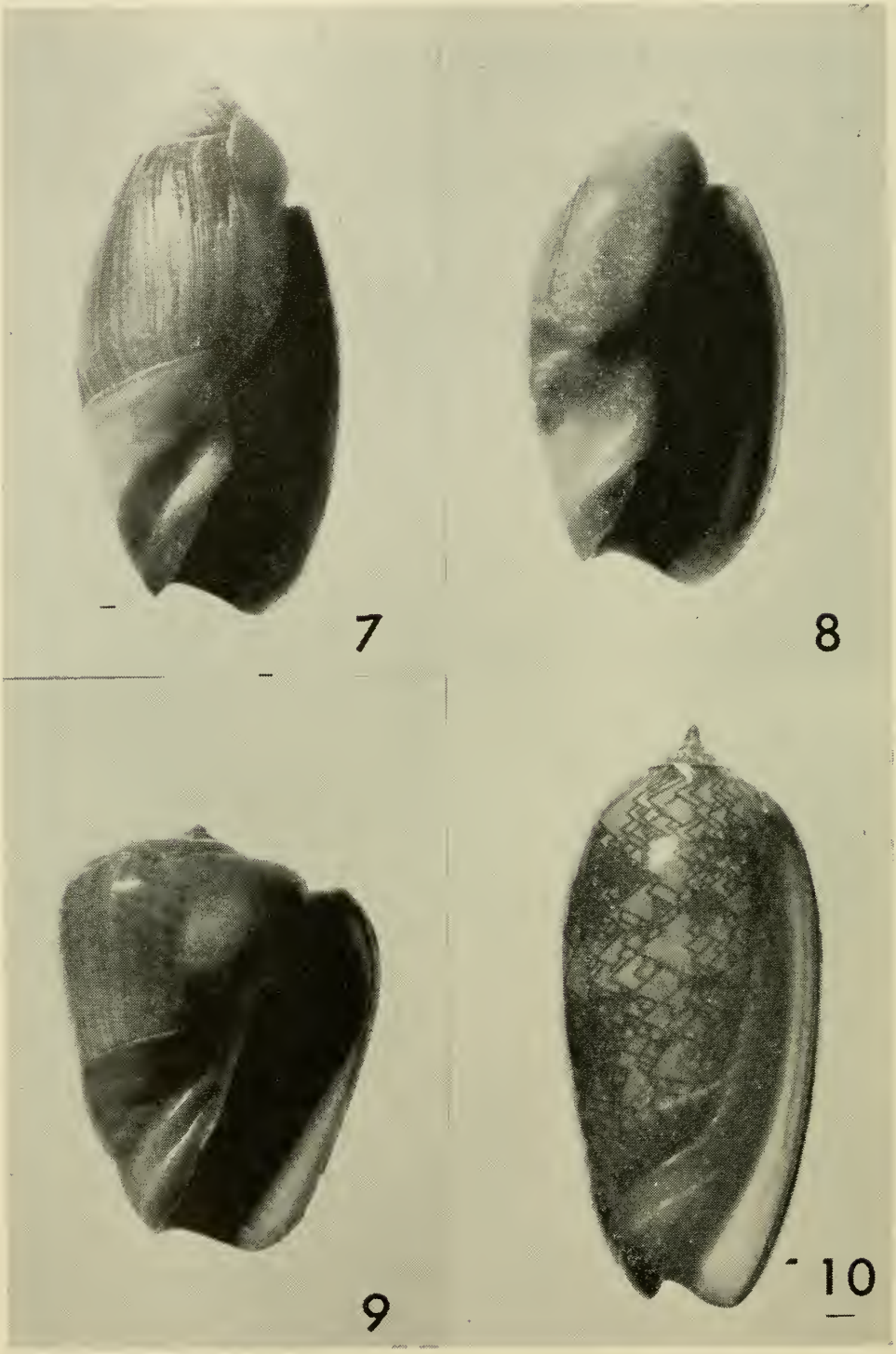

Fig. 7. *Agaronia (Olivancillaria) contortuplicata* (Reeve, 1850). Hypotype from Montevideo, Uruguay. Fig. 8. *A. (Olivancillaria) auricularia* (Lamarck, 1811). Hypotype from Cabo Frio, Rio de Janeiro state, Brazil. Fig. 9. *A. (Olivancillaria) urceus* (Roding, 1798). Hypotype from Rio Grande do Sul, Brazil. Type species of *Olivancillaria* Orbigny, 1840. Fig. 10. *Oliva prophyria* (Linnaeus, 1758). Hypotype from Panama Bay. Type species of *Oliva* Brugiere, 1789.

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REDESCRIPTION OF A COMMENSAL PELECYPOD, ROCHEFORTIA CUNEATA, WITH NOTES ON ECOLOGY

By GEORGE R. HAMPSON
Woods Hole Oceanographic Institution

The object of this paper is to describe and illustrate again *Rochefortia (Pythinella) cuneata,* a commensal pelecypod. Previous illustrations have not clearly shown the critical taxonomic characteristics to facilitate identification. Because the original description by Verrill and Bush 1898 makes no mention of the ecology of this species, and because there has been no subsequent literature on its ecology, a brief description of the association of *R. cuneata* with its host is included.

I wish to thank Dr. Howard L. Sanders (Woods Hole Oceanographic Institution), for his assistance in the preparation of this paper. and Dr. Joseph P. Morrison (U. S. National Museum) and Dr. Myra Keen (Stanford University), who kindly identified the pelecypods. I would like also to thank Dr. Robert Hessler (Woods Hole Oceanographic Institution) for his critical review and Mr. Wallace R. Bard for the illustrations. This work was supported by the National Science Foundation Grant GB 563 and is Contribution 1449 of the Woods Hole Oceanographic Institution.

ROCHEFORTIA (PYTHINELLA) CUNEATA (Verrill & Bush, 1898). Page 129, fig. 1.

Montacuta cuneata Verrill & Bush, 1898, p. 782, pl. 43, fig. 5, pl. 41, fig. 4.

Mysella (Pythinella) cuneata, Dall, 1899.

Mysella ? (Pythinella) cuneata, Thiele, 1935.

Rochefortia (Pythinella) cuneata, Morrison, 1962.

Location. Found in association with a sipunculid worm *Phascolion strombi* (Montagu), in empty shells of the gastropods *Nassarius trivittatus* (Say), and *Eupleura caudata* (Say). Specimens collected subtidally in Quisset Harbor, Falmouth, Massachusetts, at 5 meters depth, and in Buzzards Bay, Massachusetts,

(41°30'N., 70°31'W) in soft clay silt at 20 meters depth (Sanders' station R (Sanders, 1960).

Description. Small, fragile, inequilateral, from 0.4-2.5 mm. long. Adult vaguely kidney-shaped, extended anteriorly, and obtusely rounded posteriorly. Umbo, together with beaks moderate in size, raised, situated slightly posteriorly. In end view (fig. C) shell expanded dorsally, tapering to ventral margin. In side view (fig. A) ventral margin of larger valves characteristically concave; anterodorsal margin broadly convex; dorsal margin immediately posterior to umbo, shorter and slightly concave. In posterior view, margin of valves skewed to right (fig. C). Midway along ventral margin, valves broadly concave to right (fig. D). Right valve with two prominent, rounded sub-triangular cardinal teeth; anterior tooth slightly larger than posterior (fig. A); curved ossicle situated in triangular gap between cardinals; two elongate ridges continue from bases of cardinals extending anteriorly and posteriorly respectively. Left valve without cardinals; anterodorsal and posterodorsal margins infolded to level of muscle scars, forming two shelves (fig. B). Pallial line weakly inscribed, extending from dorsal edge of one scar to that of the other, and slightly concave along ventral edge; lack of pallial sinus related to absence of external siphon. Muscle scars weakly inscribed, elliptical, but pointed at either end; long axis arranged nearly parallel to vertical axis of valve. Smaller valves nearly transparent with muscle scars and internal organs clearly evident. Adult valve covered with light to dark tan periostracum. Sculpturing of shell consists of faint concentric growth lines and faint radial lines; more prominent "annular type" growth rings also discernible.

Notes on ecology. Phascolion strombi has been found to occupy empty gastropod shells in Buzzards Bay, usually of *Nassarius trivittatus,* and less frequently of *Eupleura caudata.* The sipunculid extends from the aperture into the inner whorls up to the apex of the shell. *Phascolion* is enclosed by a tube which extends into and fills the inner chambers of the shell. This tube is composed of sand grains and particulate matter cemented with mucus. Typically, the gastropod shell is positioned with the aperture facing down, allowing the everted introvert of the sipunculid to probe through the sediment.

Individuals of *Rochefortia cuneata* generally gather around a

less conspicuous passage which extends through the siphonal canal (fig. F). Typically one, or sometimes two, larger individuals are found together with several smaller specimens. They are embedded in the loosely packed sedimentary matrix and attached to the matrix by means of byssal threads. Less commonly, the bivalves are found posed around the main orifice of the sipunculid tube (not illustrated). In one case, a shell was found with a perforation in one of the whorls; around and in this perforation a few *Rochefortia* were clustered.

By observing the general feeding activity of the sipunculid, one can detect a water current with finely suspended particulate matter moving through the main aperture and the siphonal canal. These currents show that the siphonal canal connects internally with the main sipunculid tube. Movements of *Phascolion* have a direct control upon the direction of water flow through these passages. When the sipunculid everts its introvert from the shell, it induces water to be drawn into the siphonal canal to displace the volume previously occupied by the animal. Upon retraction of the worm, water is ejected through the siphonal canal. Thus, this canal appears to function as a passage for water when volumes are displaced in the movement of the animal. However, even when the sipunculid is not feeding, its slight undulating movements cause a steady current with suspended particles to pass into the siphonal canal. Smaller current movements were observed at the main orifice, but their function was not clear. In this unique manner, the tiny pelecypods are provided with a steady supply of fine organic material.

Similar sipunculid-pelecypod associations already have been reported in the literature. Perez (1924) described a commensal relationship between *Phascolion strombi,* and *Montacuta phascolionis* (Dautzenberg) in the gastropod shell of *Zizyphinus conuloides*. He found the pelecypods to occur in any location where a perforation existed which modified the circulation. Knudsen (1944) described a new pelecypod, *Jousseaumiella concharum,* which is quite similar to *Rochefortia cuneata* in its size range and ecology. His specimens were found living commensally with *Phascolion* sp., attached by byssal threads to apertures and perforations of dead *Mitra* shells. A polychaete, belonging to the family Syllidae, was mentioned as a third member of the association.

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A NEW SPECIES OF POLYCERA (NUDIBRANCHIA) FROM CALIFORNIA

By ERNST MARCUS
Universidade de Sao Paulo, Brazil

Two specimens of nudibranchs from Tomales Bay, sent in by Dr. Joel Hedgpeth, Director of the Pacific Marine Station, Dillon Beach, California, appear to represent a new species, which is here described.

Suborder Doridoidea, Tribe Phanerobranchia, Family Polyceridae.

Polycera hedgpethi, spec. nov. Page 130, figs. 1-4.

Material: Marshall's Landing, Tomales Bay, Marin County, California; 15 ft., on pipe covered with *Bugula* sp., Mr. C. I. Haydock col.; two specimens: holotype and paratype (USNM. 575603).

Description: From a photograph by Dr. Joel Hedgpeth and a drawing by Mrs. Haydock, the base color is gray with small black dots, with yellow-orange marks on the rhinophores, corners of the foot, and on the velar and extrabranchial appendages; streaks of the same color are seen on the pallial ridge, caudal crest, and upper border of the foot, and yellow orange spots are present on widely spaced tubercles all over the body. Preserved animals are light brown, mottled with dark, with the tubercles light and in part still orange, the gills blackish brown with lighter borders,

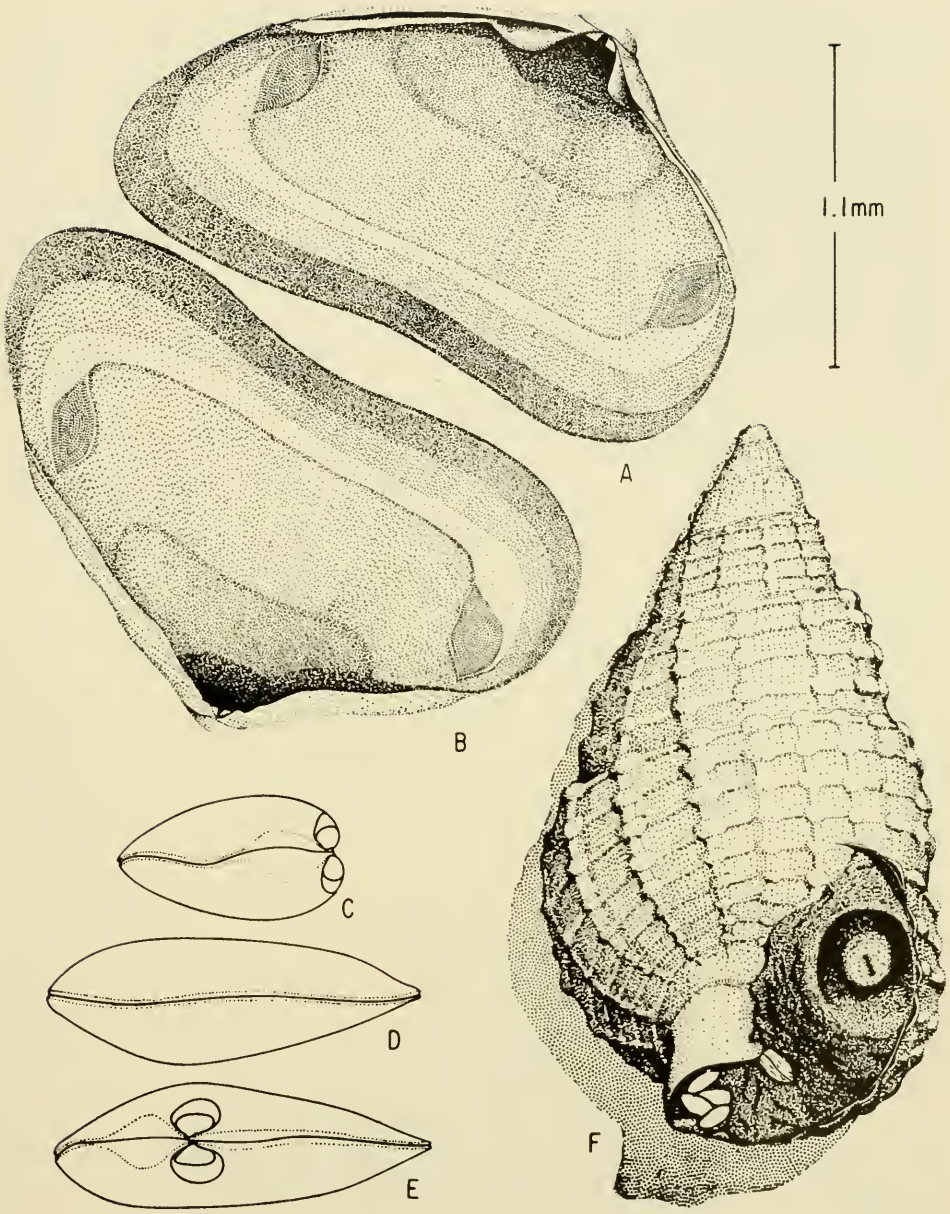
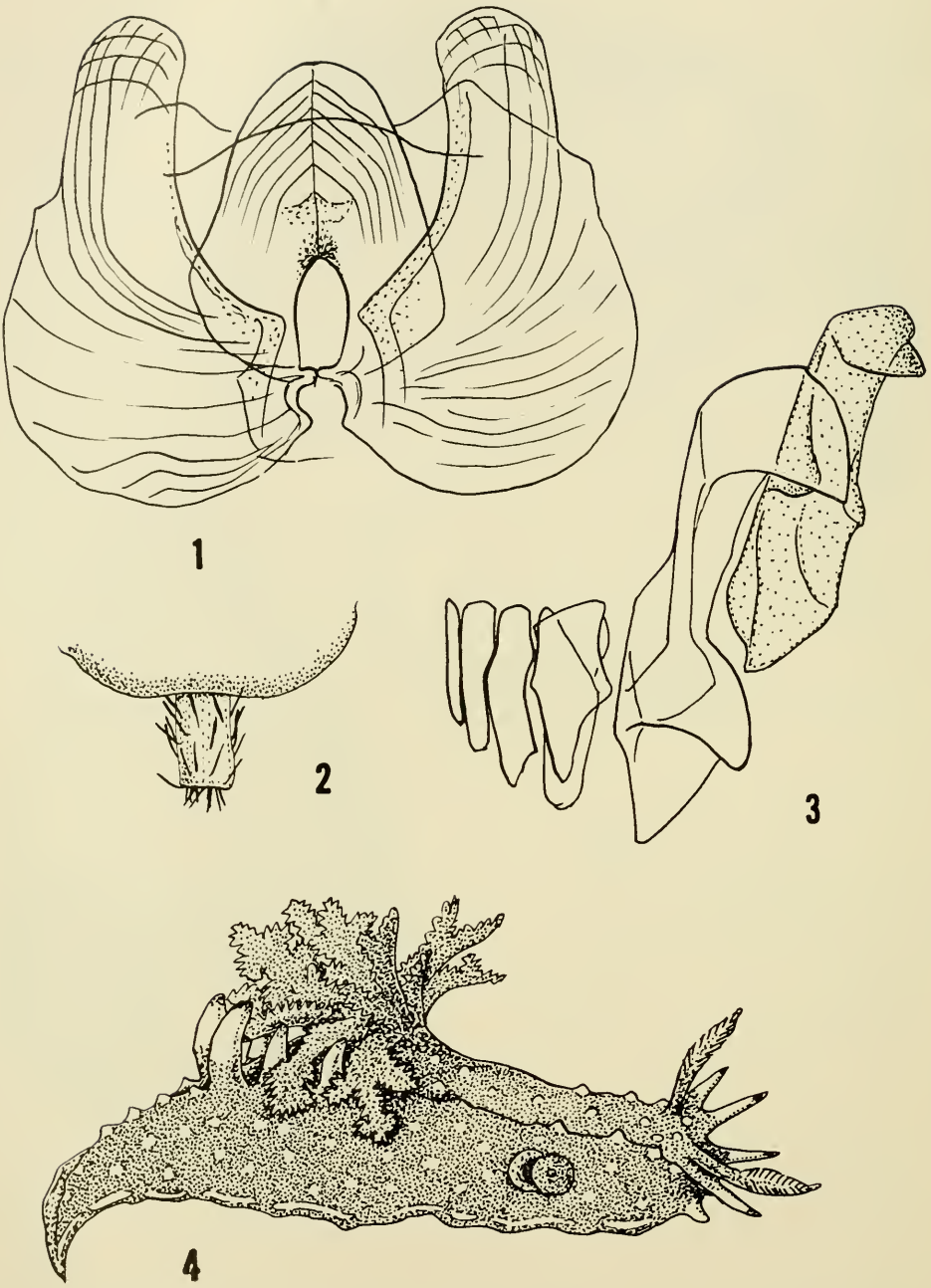


Fig. 1. *Rochefortia (Pythinella) cuneata* (Verrill & Bush, 1898). A. Right valve, medial view, B. Left valve, medial view. C. Posterior view. D. Ventral view. E. Dorsal view. F. Shell of *Nassarius trivittatus* occupied by *Phascolion strombi* and *Rochefortia cuneata*.



Figs. 1-4. *Polycrea hedgpethi,* new species: 1, jaws; 2, everted tip of penis; 3, radula, half row; 4, right side of living animal.

and the sole light. Living animals are up to 50 mm. long and 5 mm. broad when fully extended; preserved specimens are 16 and 20 mm. long, 10 mm. high, and 7-8 mm. broad.

Velum with 2-3 digitiform processes on either side. Rhinophores slender, perfoliated, with 12 leaves; oral tentacles quite short. Foot corners in one specimen more, in the other less prominent; sole narrow; tail pointed. Lateral velar appendages continuous with pallial ridges, these provided with some tubercles. Three extrabranchial appendages on each side, larger than velar ones and increasing in size posteriorly. Nine tripinnate gills. Ridges uniting behind gills, continued as tuberculate caudal crest.

Jaws pale, with wing-like processes. Radula dark red, with 17 rows; formula 3-4.2,0,2.3-4; innermost of outer teeth with rudimentary cusp; height of teeth (in micra): 430, 520, 270, 200, 180, 150. Penis with 50 long, bristle-like spines.

Named for Dr. Joel W. Hedgpeth.

Holotype: the slug and slide (jaws and radula), USNM. 575602.

Discussion: The attempt to use Odhners' key of *Polycera* (1941: 16-19) leads me to *P. zosterae* O'Donoghue (1924:7) from the Vancouver Island region; no other species published since 1941 comes closer to *hedgpethi*. *P. zosterae* is 10.25 mm. long when moving, has 5-6 short tubercles on each side of the velum, 5-6 outer teeth in the half-row of the radula, and 3 righly branched gills.

Together with the new species, I received a specimen of *Polycera atra* MacFarland (1905:50; 1906:142) from the same locality (USNM 575604). Until now, *P. atra* was only known from Monterey Bay. The specimen from Tomales Bay extends the intraspecific variation of *atra*. It has a total of 6 velar appendages, 3-4 extrabranchial tubercles on each side and 9 gills. In the original material, the corresponding numbers were 4, 1-2, and 8.

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A NEW SPECIES OF OLIVANCILLARIA FROM URUGUAY AND BRAZIL

By MIGUEL A. KLAPPENBACH
Museo Nacional de Historia Natural, Montevideo, Uruguay

Among the collections of Olividae obtained by the author in recent years for the purpose of revising the species of this family in the southwestern Atlantic, a number of lots were obtained of a form of *Olivancillaria* which, preliminarily, appeared to be young, albinistic *O. auricularia* (Lamarck). Additional specimens from the Department of Rocha, Uruguay, display constant characters, in addition to lack of pigmentation, which are of specific value in differentiating this new species from the sympatric *O. auricularia*. Some of the larger specimens of this new species have vestiges of adhered egg capsules which are ordinarily smaller than those of *auricularia*.

This new species is named in honor of Mr. Gerard W. Teague for his valuable and generous collaboration with the Museo Nacional de Historia Natural of Montevideo. This work was supported by the Conselho Nacional de Pesquisas do Brazil (Inst. Ocean. Univ. Sao Paulo).

OLIVANCILLARIA TEAGUEI, new species. Pl. 8 Figs. 1,3,4,5,8

Diagnosis: Shell relatively small (21 x 10 mm.), oval-elongated, with a short spire. Color white, except for two zones of brown-olivaceous over the numerous folds of the columellar callus, and another on the inner side of the siphonal notch.

Description: Shell sub-cylindrical, surface polished, shiny, rather thin but strong. Spire very short; suture channeled, deep, and partially filled (first whorls) with materials from the callus. Apex obtuse, rounded, very small and mammillate. Four whorls. Columellar callus not very developed, rather thin, but very conspicuous, less lustrous than the rest of the shell, and extending beyond the suture. Under magnification the surface of the callus shows a punctiform surface, opaque. Aperture subtriangular, elongated and narrow, its length corresponding approximately to 4/5 of the total length of the shell. Outer lip smooth, simple and sharp, slightly curved. Columella almost straight from a ventral view, with two, very weak sinuosities on the concave anterior third and one other on the lower convex third. Turning the shell clockwise, one can observe a small notch, produced by the rotation of the basal fold; above this there is a series of smaller folds (figs. 4, 5), 10 in number, parallel, and slightly slanting with respect to the columellar axis, extended over the zone limited by

the fasciole band. On the outer side of the callus, there are 4 other larger folds, running in a position almost perpendicular to the smaller ones, that is, in the same direction as the columellar axis. The fasciole band rather wide, well limited above, but without precise limits below. Color white, shiny, but on the zone of the callus and its extension rather dull, with brown-violaceous spot on the smaller, interior folds, and another on the siphonal notch. Without operculum. Radular ribbon with 90 rows of teeth; rachidian tooth tricuspidate (fig. 8).

Measurements (holotype): Length 21.0 mm. Width 10.5 mm. Aperture: length 17.5 mm., width 5.0 mm.

Holotype: Mus. Nac. Hist. Nat. Montevideo, Mollusks Collection No. 1238. Collected by M. Souza, January 1960. Type locality: La Coronilla, Department of Rocha, Republic of Uruguay.

Paratypes: Paratypes in the Mus. Nac. Hist. Nat. Montevideo (all from La Coronilla): no. 1218 (coll. E. Duarte, Mar. 1957); no. 1230 (coll. E. H. Ureta, Mar. 1959); no. 1237 (coll. M. Souza, Jan. 1960); no. 1241 (coll. F. Mane-Garzon, Feb. 1960). Paratypes in the Mus. Ocean. Rio Grande do Sul, Brasil: no. 8845 (from Chui, Rio Grande do Sul, Brasil, Jan. 1963).

Three paratypes in the collection of the Academy of Natural Sciences of Philadelphia (no. 290783). The average measurements of all specimens: 19.5 x 9.5; aperture: 15.5 x 4.5 mm.

Remarks: In some specimens, the number of horizontal folds is reduced to 8; the vertical ordinarily 4, only one specimen with 3, or the fourth is vaguely suggested. The spots on the folds are very constant, varying only in intensity and size. The spot on the siphonal notch is lacking in only one specimen of lot no. 1230. These spots are of stronger violaceous color in live specimens or for a short time after being collected; after several months the violaceous hue is less intense and more brownish. Some specimens have below the fasciole band a yellowish tinge.

Distribution: The new species is known to date from the type locality in Uruguay and from Chui, Rio Grande do Sul, Brazil; in shallow water on sandy bottoms, uncovered at low tide.

Comparisons: O. teaguei is easily separable from all other species of the genus in the region, such as *O. urceus* (Johnson, 1915), *O. contortuplicata, O. deshayesiana* (Carcelles, 1944; Lange de Morretes, 1949). In shape it is close to *O. auricularia* which is always more ventrose, with the outer lip stronger and very curved (more "auriculed" and reaches a larger size. In the Museum at Montevideo, a specimen from the Brazilian coast measured 67

mm., although in La Coronilla they do not exceed 50 mm. Also, the last whorl in *auricularia* is bluish, with the fasciole band and adjacent zone pale-brown, while *teaguei* is entirely white (except for the mentioned spots which are not present in *auricularia),* has an interior of violaceous-brown, is clearer on the outer lip and on the siphonal notch. *O. auricularia* (figs. 6, 7) has only 4 or 5 horizontal folds which are thick and parallel and very short above the basal fold, and has the rest of the columellar callus completely smooth. The columellar callus extends to the apex, which generally is covered by the enamel, while in *O. teaguei* the apex is free.

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THREE NEW UNIONIDS FROM ALABAMA AND FLORIDA AND A NOTE ON LAMPSILIS JONESI

By HERBERT D. ATHEARN
Cleveland, Tennessee

Few new species of unionids may be found in North America today. Most areas have been well explored, especially the Alabama and Tennessee River systems which still support an exceedingly rich unionid fauna. The greatly varied *Elliptio* fauna of central Florida has been well collected and many names have been applied to its forms. The streams of western Florida have not been so thoroughly worked. This statement appears to be particularly applicable to the lower Choctawhatchee, the Yellow, the lower Escambia and the Perdido Rivers. Two of the new unionids described herein are from one of these streams, the Choctawhatchee River.

Alasmidonta mccordi, new species. Plate 9, figs. a, b.

Description. Shell medium-small in size, the type 58 mm. (about 2¼ inches) in length, oval in outline, fairly thin in structure and inflated. Color tawny with broad and narrow rays of dark green which are strongest on the disc. Posterior slope slightly concave

below the ligament. Posterior ridge low, rounded. Umbos slightly anterior of center, fairly high, swollen and turned forward over a lunule. The portion of the disc behind the posterior ridge is moderately swollen. Shell tapers off abruptly anteriorly. Periostracum shining on the disc, roughened posteriorly and becoming cloth-like anteriorly where it exhibits many fine growth lines.

Nacre pearly, slightly iridescent, blotched in the vicinity of the beak cavity. Pseudocardinal teeth small, erect, one in the left valve and with the vestige of another behind it; two in the right valve. Lateral teeth nearly absent, there being a vestige of a single one in the left valve and a double one in the right valve. Muscle scars large, the anterior adductor scar somewhat impressed.

Type. Holotype is deposited in the National Museum of Canada as catalogue number 20094. No other specimens are known to exist at the present time. Holotype collected by the author on August 2, 1956. Measurements: length 58 mm, height 40 mm, breadth 25 mm.

Type Locality. Coosa River, Ten Island Shoals, just below old Lock 2 Dam, three and two-tenths miles south of Greenport, St. Clair County, Alabama.

Remarks. This specimen was collected alive on a sand and gravelly bottom which was thickly strewn with rock debris from Lock 2 Dam. The water here was swift and shallow. The valves are slightly mis-shapen and the growth lines are not entirely concentric. Apparently during its juvenile stage, this specimen was wedged between two rocks. Certainly this does not account for its appearance of uniqueness as a new species, however.

This species does not closely resemble any other American species. Exteriorly, the shell may be compared with *Alasmidonta calceola* Lea. *A. mccordi* is much higher and a little more inflated than the latter. Its rays are narrower and more widely spaced but like *A. calceola,* these rays extend across the entire disc. Interiorly, the hinge teeth resemble those of *Lasmigona holstonia* Lea. The delicate cardinal teeth are located slightly forward of the beak cavity as in *L. holstonia.*

This species is named in honor of John McCord of Cleveland, Tennessee, an esteemed colleague.

LAMPSILIS HADDLETONI, new species. Plate 9, figs. h, g.

Description.—Shell rather small in size, mature specimens measuring 30 mm. (1 3/16 inches) in length, subelliptical in outline, thin in structure, scarcely inflated, and with the lip only slightly thickened. Color tawny, smoky on the disc and anteriorly with

well defined narrow rays on the posterior slope. Posterior ridge low, rounded, having a very slight tendency to be double. Umbones anterior of center, low and much corroded. Beak sculpture not seen. A dorsal view of both type specimens shows their greatest diameter to be centrally located. Ligament tawny, moderate in width and about ¼ length of shell. Periostracum smooth and shining over the entire surface and having a waxy appearance.

Nacre flesh colored dorsally and anteriorly, pearly along the ventral margin and posteriorly, and very iridescent posteriorly. Anterior muscle scars deep and well defined. Posterior scars faint and with nacre iridescent within. Lelt valve with 2 curved laterals and 2 pseudocardinal teeth. Right valve with one curved lateral tooth, one stubby pseudocardinal tooth and two vestigial pseudocardinal teeth.

Type lot.—Holotype is deposited in the National Museum of Canada as catalogue number 20095. The paratype is in the collection of the author as catalogue number 6705. These two mature specimens were collected by the author on September 23, 1956.

Measurements			
Length (mm)	Height (mm)	Breadth (mm)	
30	23	12.5	Holotype.
30.5	22	12.5	Paratype.
Length	Height	Breadth	

Type Locality.—Choctawhatchee River, West Fork, seven miles southwest of Ozark, Dale County, Alabama.

Remarks.—The distribution of this species is probably restricted to the headwaters of the Choctawhatchee River system, where it is very rarely found. The type shells were collected on a shoal which was xtensively worked over with a hoe. *L. haddletoni* appears somewhat similiar to *L. ochracea* Say. It is smaller than that species, less inflated, the shell thicker, and the cardinal teeth are much larger. The species differs from *Villosa choctawensis* Athearn (herein described by its orbicular outline, flesh colored nacre and in particular in the coloration of the epidermis. The epidermis of *L. haddletoni* is darker anteriorly on the disc while it is lighter near the ventral margin and on the posterior slope. Rays are prominent only on the posterior slope. The epidermis of adult *V. choctawensis* is dark throughout except in the vicinity of the umbones where it appears lighter and exhibits fine rays.

I take pleasure in naming this species after my good friend and colleague Arthur Haddleton Clarke, Jr. of the National Museum of Canada.

VILLOSA CHOCTAWENSIS, new species. Plate 9, figs. c, d, e, f.

Description.—Shell small in size, measuring up to 42 mm (about 1 5/8 inches) in length, subelliptical in outline, moderately thin in structure, somewhat inflated, and with the lip slightly thickened. Color brownish black to chestnut brown, often lighter in the vicinity of the umbones, young specimens usually a greenish brown and often exhibiting fine rays. Posterior ridge poorly defined, low and rounded. Sexual dimorphism pronounced. Female specimens truncate or widely rounded posteriorly, male specimens more evenly rounded and sometimes bluntly pointed. In addition, females are usually slightly more inflated. Umbones well anterior to center, wide and full. Beak sculpture consisting of 4 or 5 thin and slightly undulating ridges. Greatest diameter of shell just behind the beaks. Ligament about 1/4 length of the shell and of moderate width. Periostracum usually smooth and shining on the upper disc, but roughened closer to the ventral margin and on the posterior slope.

Nacre consistently whitish in color, sometimes slightly blotched and somewhat iridescent posteriorly. Anterior muscle scars well defined, the adductor scar being especially deep. Posterior scars poorly defined. Left valve with 2 laterals and 2 pseudocardinal teeth. Right valve with one lateral tooth and the vestige of a second, one large erect pseudocardinal tooth and usually 2 vestigial pseudocardinal teeth.

Type lot.—Holotype, NMC 20096 deposited in the National Museum of Canada. Paratypes are deposited in the United States National Museum, Museum of Comparative Zoology, Academy of Natural Sciences of Philadelphia, University of Michigan Museum of Zoology, Florida State Museum and the collection of the author. Type and paratypes collected by the author on November 28, 1958.

Measurements

Length (mm)	Height (mm)	Breadth (mm)	
37	26	16.5	Holotype.
32	23	14	Paratype from type locality.
42	27	18.5	Choctawhatchee R., Roaring Cutoff,
34	24.5	15	2.6 mi. NE of Redbay, Walton Co., Florida.
38	27	18	Choctawhatchee R., about 3½ mi. SE
35	25	16	Hinsons Cross Roads, Washington Co., Florida.
30	21	13.5	Choctawhatchee R., Waterford, 1.1 mi. N. of Newton, Dale Co., Alabama.

Type Locality.—Choctawhatchee River, two miles southwest of Caryville; about one mile downstream from U. S. Highway 90, Holmes County, Florida.

Remarks.—V. choctawensis lives in moderate to swiftly moving water, on sandy bottom. The type specimens were collected on sandy bottom which was free of mud. In this kind of environment, the periostracum tends to be rather shining on the disc. On sand bars which contain mud rich in vegetable detritus, the species grows larger and the periostracum becomes coarser with heavier lines of growth. The Roaring Cutoff lot is of this latter sort.

V. choctawensis has probably been mistaken for *Pleurobema strodeanum* B. H. Wright by collectors in the past. The males of *V. choctawensis* are strikingly similar to that species. However, they lack the consistently well defined posterior ridge of *P. strodeanum*. The male and female shells of *P. strodeanum* are essentially alike as is characteristic of shells of the genus *Pleurobema* (Simpson, 1914) . Sexual dimorphism is well defined in specimens of *V. choctawensis*.

The nacre of the posterior area of *V. choctawensis* lacks most of the bluish appearance found in that area in *P. strodeanum*. *V. choctawensis* is in some respects similar to *V. villosa* B. H. Wright but is much shorter than that species.

This species is named in honor of the Choctaw Indians.

Lampsilis jonesi van der Schalie.

Clench and Turner (1956) list the known naiades of west Florida together with their descriptions and much other valuable data. Their synonomy of *Lampsilis jonesi* van der Schalie as *Lampsilis australis* Simpson, however, is not correct. These two species may be distinguished as follows: the posterior ridge of *L. jonesi* is double with each valve exhibiting a characteristic scalloped edge between the extremities of these ridges; the periostracum of *L. jonesi* is somewhat coarser than that of *L. australis*, the latter species exhibiting a smooth, often glossy effect; *L. jonesi* is more cylindrically shaped while the lateral outline of *L. australis* is rather evenly elliptical and the shell not so inflated. The two species were collected from the same shoal of the West Fork, Choctawhatchee River, about 7 miles SE of Ozark, Dale County, Alabama. I experienced no difficulty in separating the 35 specimens of *L. australis* from the 98 specimens of *L. jonesi* taken at

that station.

Sexual dimorphism is well pronounced in the adult stages of *L. jonesi*. Female specimens exhibit a general swelling of the disc below the posterior ridge. In *L. australis* sexual dimorphism sometimes may be noted, but only by a greater rounding of the ventral margin.

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NOTES AND NEWS

Formation of an epiphragm and true aestivation in Melampidae.[1]—Members of the family Melampidae are usually considered as extremely primitive Pulmonata. In particular, up to now, they have been regarded as incapable of any specialized means for hibernation or aestivation under conditions seasonally unfavorable for activity. It is believed that epiphragm formation by members of the family Melampidae is recorded here for the first time.

Allochroa layardi H. & A. Adams 1855 was collected in numbers in apertures and pockets on the under side of coralline rubble and slabs, on the exposed reef along the south side of Amedee Island, about 12 miles off Noumea, New Caledonia, on December 15, 1960. These individuals were not active, but were resting on the walls of these (sometimes tiny) openings when found. Each one had to be detached, and picked, shaken, or jarred out of these blind holes in the coralline rock pieces. Upon checking their specific characters under the microscope, I discovered that the majority of these shells showed an epiphragm at the aperture, that had sealed the shells against excessive loss of moisture, and had fixed them against the rock surface in their hiding places. Apparently this is not an accidental or isolated

[1] Published by permission of the Secretary of the Smithsonian Institution.

occurrence. The only other specimen of this *Allochroa* species I collected alive on New Caledonia shows the same thing. The locality was the rocky, upper intertidal zone on the northwest side of N'GO Bay, between 50 and 150 metres from the mouth of the bay. In other words, this is on the practically open, exposed rocky salt water shore line of the main island of New Caledonia. Here under pieces of coralline rock, and in pockets on the under side of these coralline rocks, one specimen of *Allochroa layardi,* and a number of *Laemodonta lirata* H. & A. Adams 1854 were collected on January 14, 1961. The *Allochroa,* and a few individuals of the *Laemodonta* from this habitat show epiphragm formation.

In a larger sample I collected on the shore of the Baie de Prony, a number of *Laemodonta lirata* individuals showed evidence of epiphragm formation in sealing themselves onto the under surfaces of the rocks under which they live. This was also true of some of the specimens of *Cassidula paludosa* Garrett 1872, found living under the same rocks on January 1, 1961. In still another sample from the Baie de Prony, a single *Laemodonta lirata* individual was sealed onto the rock with an epiphragm formation, when collected on January 2, 1961.

All these shells were dropped into alcohol when collected, and later were packaged in cheese-cloth in alcohol drums for shipment, yet they still show this epiphragm formation after drying for permanent placement in the United States National Museum collections.

To summarize, certain members of the very primitive pulmonate family Melampidae, namely *Allochroa layardi* H. & A. Adams 1855, *Laemodonta lirata* H. & A. Adams 1854, and (occasionally) *Cassidula paludosa* Garrett 1872, do aestivate (with the formation of an epiphragm) under the upper intertidal rocks of southern New Caledonia shore lines in the hotter summer season. —J. P. E. Morrison.

Some of Rafinesque's unionid names.—Almost half a century ago, A. E. Ortmann and Bryant Walker, 1922, Occ. Papers Mus. Zoo. Univ. Mich. 112, with notes by H. A. Pilsbry, made a careful survey of the nomenclature of North American unionoids, with special attention to the bewildering confusion of terms pro-

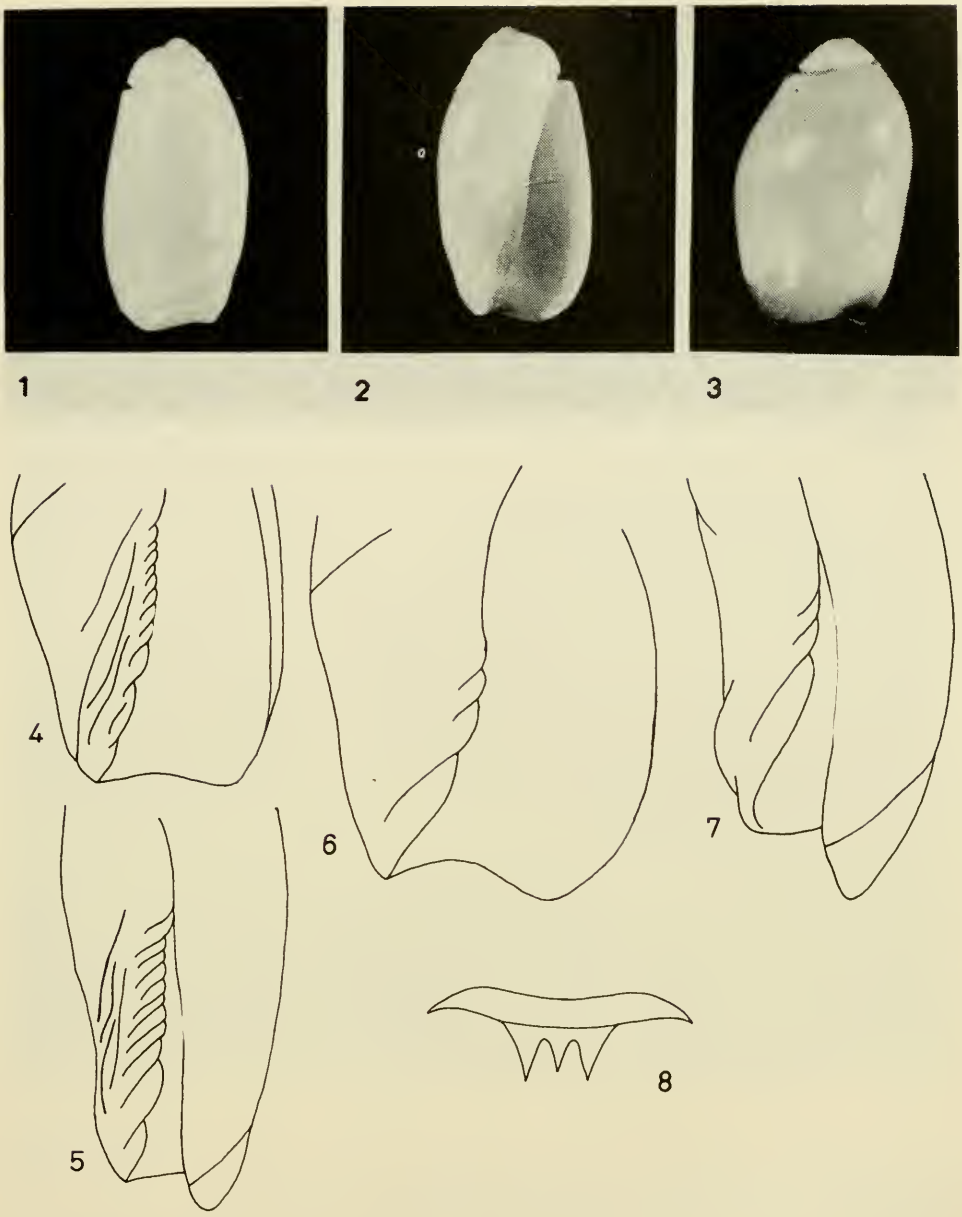
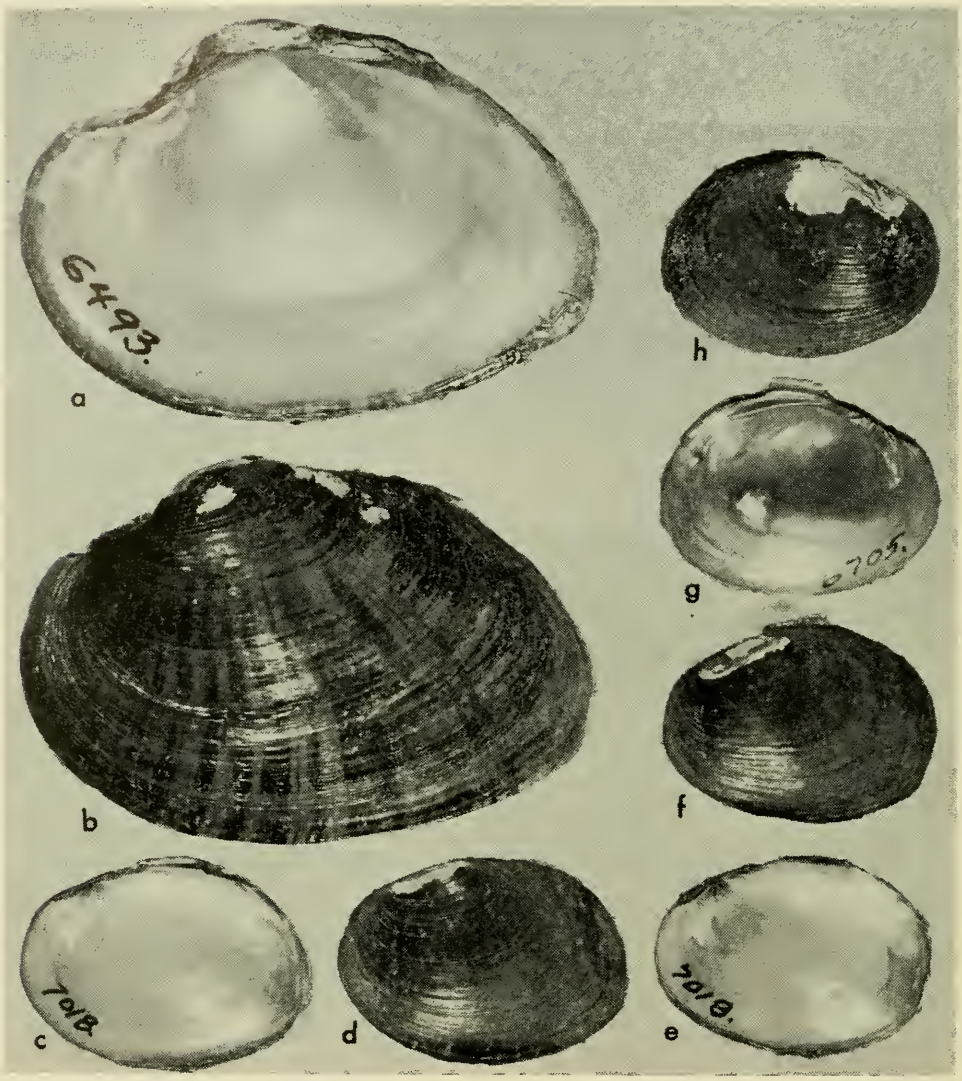


Fig. 1. *Olivancillaria teaguei* n. sp., shell, holotype, dorsal view. Fig. 2. The same, apertural view. Fig. 3. *O. auricularia* (Lamarck), dorsal view, length 22 mm. Fig. 4. *O. teaguei,* mouth with pillar structure. Fig. 5. The same, rotated. Fig. 6. *O auricularia,* mouth with pillar structure. Fig. 7. The same, rotated. Fig. 8. *O. teaguei,* rachidian tooth.



Figs. a-b. *Alasmidonta mccordi* Athearn, holotype. Figs. c-f. *Villosa choctawensis* Athearn, paratypes from type locality (c-d, male; e-f, female). Figs. g-h. *Lampsilis haddletoni* Athearn, paratypes.

posed by Rafinesque, 1819, 1820 and 1831.[1] In the cases of *Lemiox, Lasmonos, Toxolasma,* etc., O. & W. wisely decided that, since the type species of these names were unidentifiable, the generic names also became "nomina dubia" and should be rejected. With this, I agree thoroughly.

On the other hand, in their discussions of *Lastena* (p. 32) and *Plagiola* (p. 51), they rejected Herrmannsen's (1847) subsequent selections, because his type species were unidentifiable [with which I also agree] but accepted still later selections for these cognomens [which is not permissible]. Since *Anodonta ohiensis* Raf., 1820: 316, is not identifiable, *Lastena* Raf. (loc. cit.) also must be rejected completely, and for still another reason; Raf. (loc. cit.) did not include *A. lata* in *Lastena* sensu stricto, but proposed another subgenus *Hemistena* for it, which is Frierson's (1927) correct generic name of *Hemistena lata* (Raf.). [I think this has been discussed previously, but forget by whom.]

Similarly, since *Obliquaria interrupta* Raf., 1820: 302, is not identifiable, *Plagiola* Raf. (1819) also must be a "nomen dubium" unless the I.C.Z.N. set aside Herrmannsen's type selection, and validate *Plagiola,* as generally used. Incidentally, the Poulson "type" of *interrupta* is a *Dysnomia (Truncillopsis)* but Frierson (1927) guessed the name to apply to a *Ligumia.* However, the specific name also is not preoccupied for two reasons; according to the present "code" [article 58 (e)] a name "proposed for a species takes precedence over one proposed for a subspecies." Apparently, the legal name for *"Plagiola"* is *Ellipsaria* Raf., 1820: 303, type by absolute tautonymy *Obliquaria ellipsaria* Raf. O. & W. agreed that this name is a synonym of *"Plagiola" lineolata* (Raf.).

A usage of another Rafinesque name also is considered incorrect, for the same reasons as those discussed under *Lastena.* In 1914, Naut. *28:*7, Frierson correctly selected *D. marginata* Raf. as the type species of *Diplasma* Raf., 1831:6, and apparently thought it to be *Lamellidens marginalis* (Lamarck). Of course, Frierson's later (1927, A classified and annotated check list of N. A. naiades, appendix) selection is invalid, also partly because Raf. (loc. cit.) did not include *D. vitrea* in his *Diplasma* s.s., but in his "subgenus" *Hemisolasma,* 1831:7, for which *D. vitrea* now

[1] See bibliography of O. & W.: 72-75 for full references.

is selected the type species. If the last name be identifiable (and Frierson's argument is rather convincing), *Hemisolasma vitrea* might replace *Unio olivarius* Lea, 1834 (1831, preprint?) and *Hemisolasma* is prior to *Nodularia* Conrad, 1853. Evidently, "Diplasminae" Modell, 1942, Arch. Molluskenk. *74*:177, was based on Frierson's second and invalid type selection.—H. Burrington Baker.

Dromus not a homonym.—*Dromus* Simpson, 1900, Proc. U. S. Nat. Mus. *22*: 614, "Type, *Unio dromus* Lea," evidently is not a homonym, since "Dromus" Selby, 1840, Cat. Typ. Birds: 45, plainly is an "incorrect subsequent spelling" instead of an intentional emendation. Under the present "code," unless an undiscovered emendation prior to 1900 preoccupies, *Conchodromus* Haas, 1930, Senckenbergiana *12*: 317, was an unnecessary substitute and becomes a junior synonym. —H. Burrington Baker.

Correction:—In Nautilus *77*:101, the figure in the upper right is *Rhytidothyra bilabiata* (Orbigny) and that in the upper left is *R. jacobsoni* Alcalde, as is the bottom figure of sculpture. The two species were put on one plate for purposes of comparison. —Morris K. Jacobson.

Gulella (Huttonella) bicolor (Hutton).—Dr. L. A. W. C. Venmans has recently published an excellent paper on the Streptaxidae of the Caribbean area (1963, Studies on the Fauna of Curacao and other Caribbean Islands *14*:41-76). Under the above species I would like to add the following localities, as they extend the range considerably. His northernmost records were from the Virgin Islands.

Hispaniola: Puerto Sosua, República Dominicana.

Cuba: Jardin Botanico, Habana, Habana Prov.; Cardenas, Matanzas Prov.; El Pureo, Calabazar, Las Villas Prov.; Isla de Pinos.

North America: St. Peter's Cemetery, Charleston, South Carolina. H. Vander Schalie has reported this species from Guayama, Puerto Rico (1948, Univ. of Michigan, Mus. of Zoology, Misc. Publications *70*:68) and M. K. Jacobson from Coconut Grove, Florida (1957, Nautilus *71 (2)*:iii).

In addition, the Museum of Comparative Zoology has specimens from the following places:

Brasil: Manaos.
French Guiana: Cayenne.
Marquesas Ids.: Nuka Hiva.
Fiji Ids.: near Lautoka, Viti Levu.
Caroline Ids.: Yap.
Marianas Ids.: Guam.
Japan: Okinoerabushima, Ryukyu Ids.
Philippine Ids.: Manilla, Luzon; Boac, Marinduque; Palo, Leyte; Lubang Id.; Calapan, Mindoro; Dapitan, Mindanao.
Africa: Mombasa, Kenya.
Madagascar: Nossi Bé. — William J. Clench.

Corbicula fluminea at Vicksburg, Mississippi.—On October 13, 1963 *Corbicula fluminea* (Müller) was found abundant in the Yazoo River at the foot of China Street, Vicksburg, Miss. It was also found in the Yazoo River at the old Eagle Lake Ferry landing, 7.5 miles north of Vicksburg, but not as abundantly. It was not found in the Yazoo River north of Redwood, nor at Satartia. —Leslie Hubricht.

Psilarius, new name for *Leptarius* Woodring, 1964, not *Leptarius* Gill, 1864 (Gastropoda, Nassariidae).—Through a regrettable oversight *Leptarius,* recently named as a monotypic genus of the family Nassariidae (Woodring, U. S. Geological Survey Prof. Paper 306-C, p. 272, 1964), is a junior homonym of *Leptarius* Gill (Acad. Nat. Sci. Phila. Proc., 1863, p. 170, 1864). *Psilarius* is proposed as a substitute name. The type species is *Leptarius leptus* Woodring, now *Psilarius leptus* (Woodring), a middle Miocene species from the Gatun formation of the Panama Canal Zone. —W. P. Woodring.

American Malacological Union.—The 30th annual meeting will be held July 21 to 24, 1964, in New Orleans, Louisiana.

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Vol. 77 JULY, 1963 No. 1

THE NAUTILUS

THE PILSBRY QUARTERLY
DEVOTED TO THE INTERESTS OF CONCHOLOGISTS

EDITORS AND PUBLISHERS

HORACE BURRINGTON BAKER, 11 Chelten Road, Havertown, Pa.
(Emeritus Professor of Zoology, University of Pennsylvania)

CHARLES B. WURTZ, *Consulting Biologists Inc.*,
Bethlehem Pike, Spring House, Pa.

R. TUCKER ABBOTT, Henry A. Pilsbry Chair of Malacology
Academy of Natural Sciences, Philadelphia 3

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11 Chelten Road, Havertown, Pennsylvania

Second-Class Postage paid at Spring House, Pa.

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NAUTILUS:

A Quarterly Journal devoted to the study of Mollusks, edited and published by Horace B. Baker, Charles B. Wurtz and R. Tucker Abbott.

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